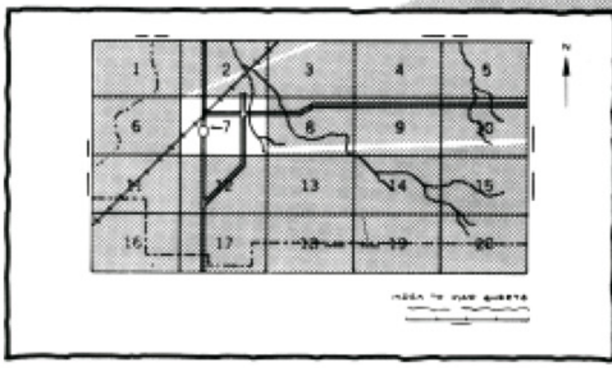
Soil Survey of

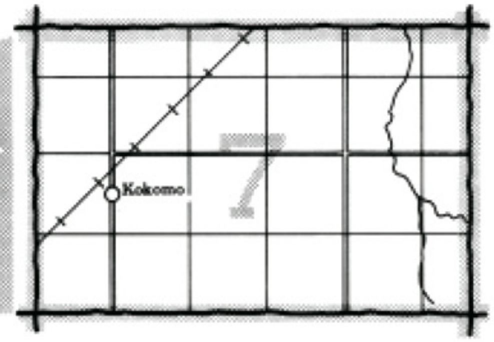
Grant County, South Dakota

United States Department of Agriculture
Soil Conservation Service
in cooperation with
South Dakota Agricultural Experiment Station

HOW TO USE

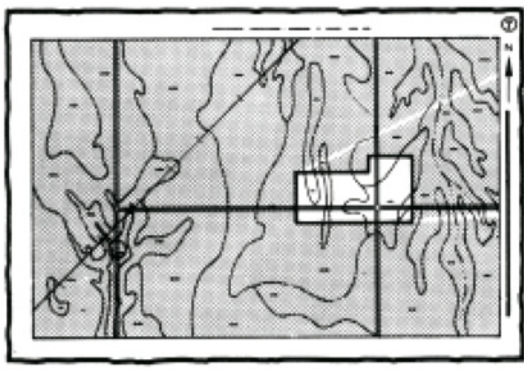
1. Locate your area of interest on the "Index to Map Sheets"

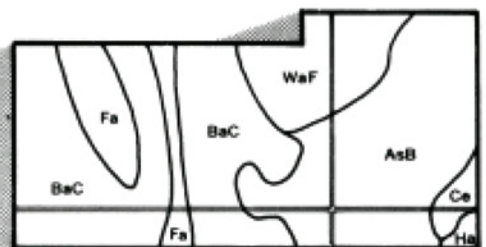




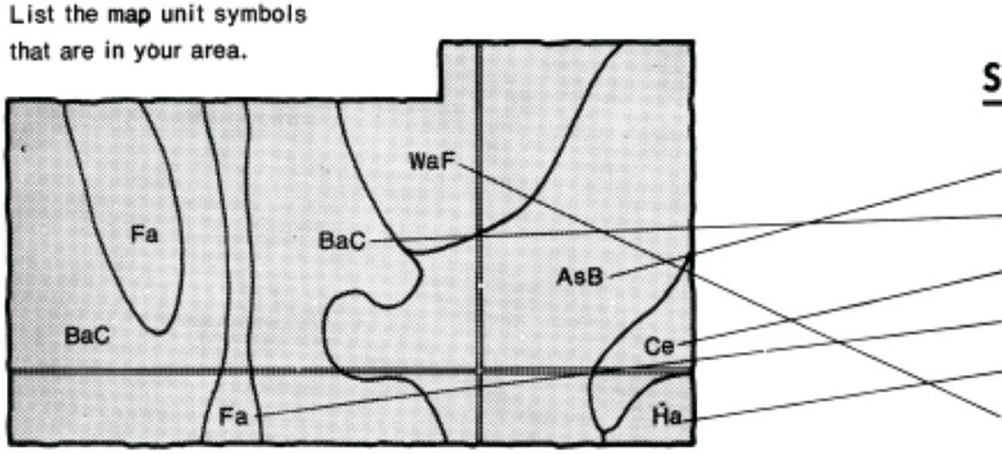
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.





4. List the map unit symbols that are in your area.



Symbols

AsB
BaC
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Fa
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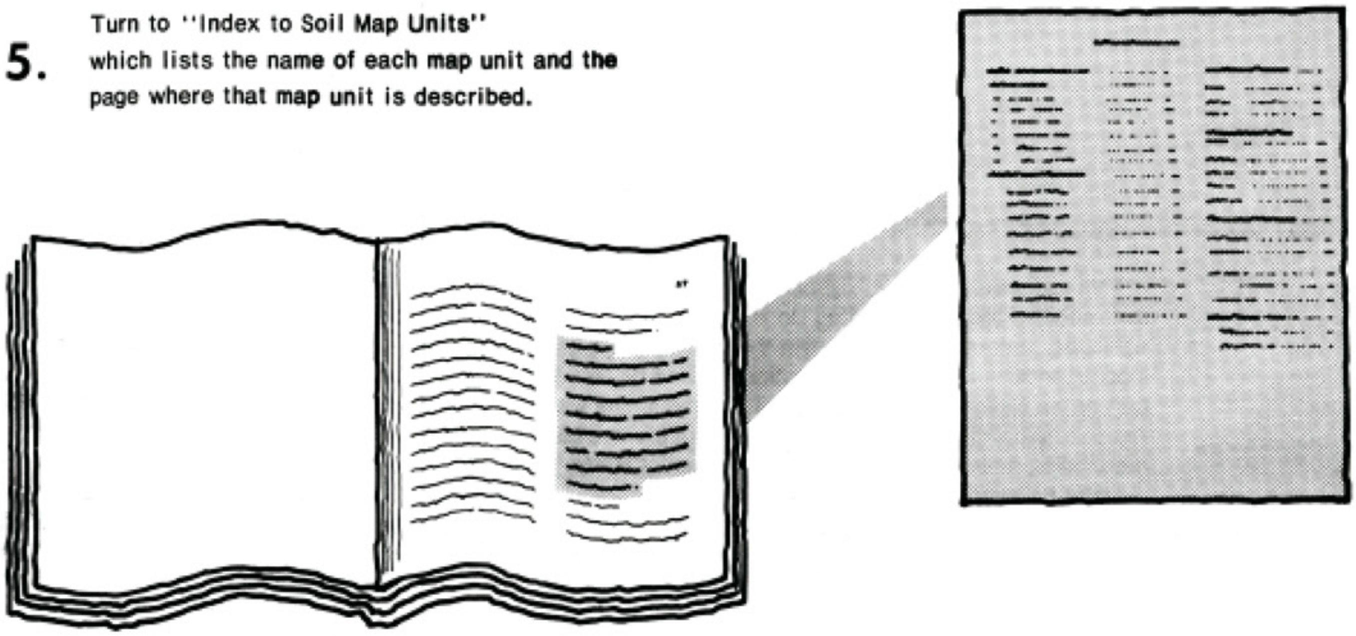
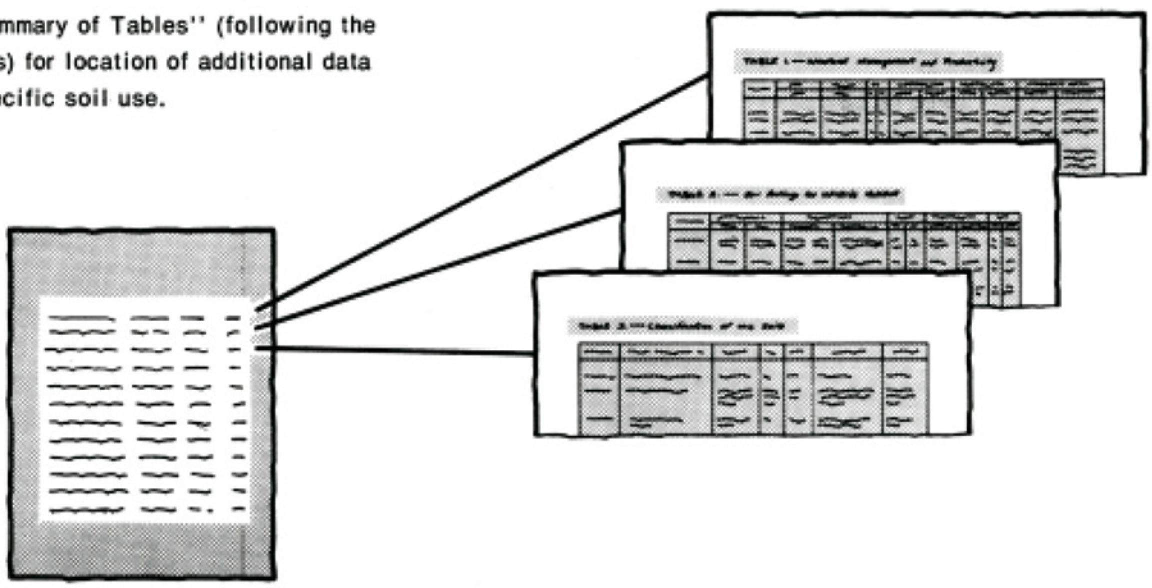
THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was performed in the period 1971-1976. Soil names and descriptions were approved in 1977. Unless otherwise indicated, statements in the publication refer to conditions in the survey area in 1977. This survey was made cooperatively by the Soil Conservation Service and the South Dakota Agricultural Experiment Station. It is part of the technical assistance furnished to the Grant County Conservation District.

Soil maps in this survey may be copied without permission, but any enlargement of these maps can cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

Cover: Single row field windbreak planted on the contour in an area of Vienna-Lismore silt loams, 1 to 6 percent slopes.

Contents

Issued December 1979

Index to map units

Summary of tables

Foreword

This soil survey contains much information useful in land-planning programs in Grant County, South Dakota. Of prime importance are the predictions of soil behavior for selected land uses. Also highlighted are limitations or hazards to land uses that are inherent in the soil, improvements needed to overcome these limitations, and the impact that selected land uses will have on the environment.

This soil survey has been prepared for many different users. Farmers, ranchers, foresters, and agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use it to plan land use, select sites for construction, develop soil resources, or identify any special practices that may be needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the soil survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may be shallow to bedrock. They may be too unstable to be used as a foundation for buildings or roads. Very clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map; the location of each kind of soil is shown on detailed soil maps. Each kind of soil in the survey area is described, and much information is given about each soil for specific uses. Additional information or assistance in using this publication can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

R. D. Swenson

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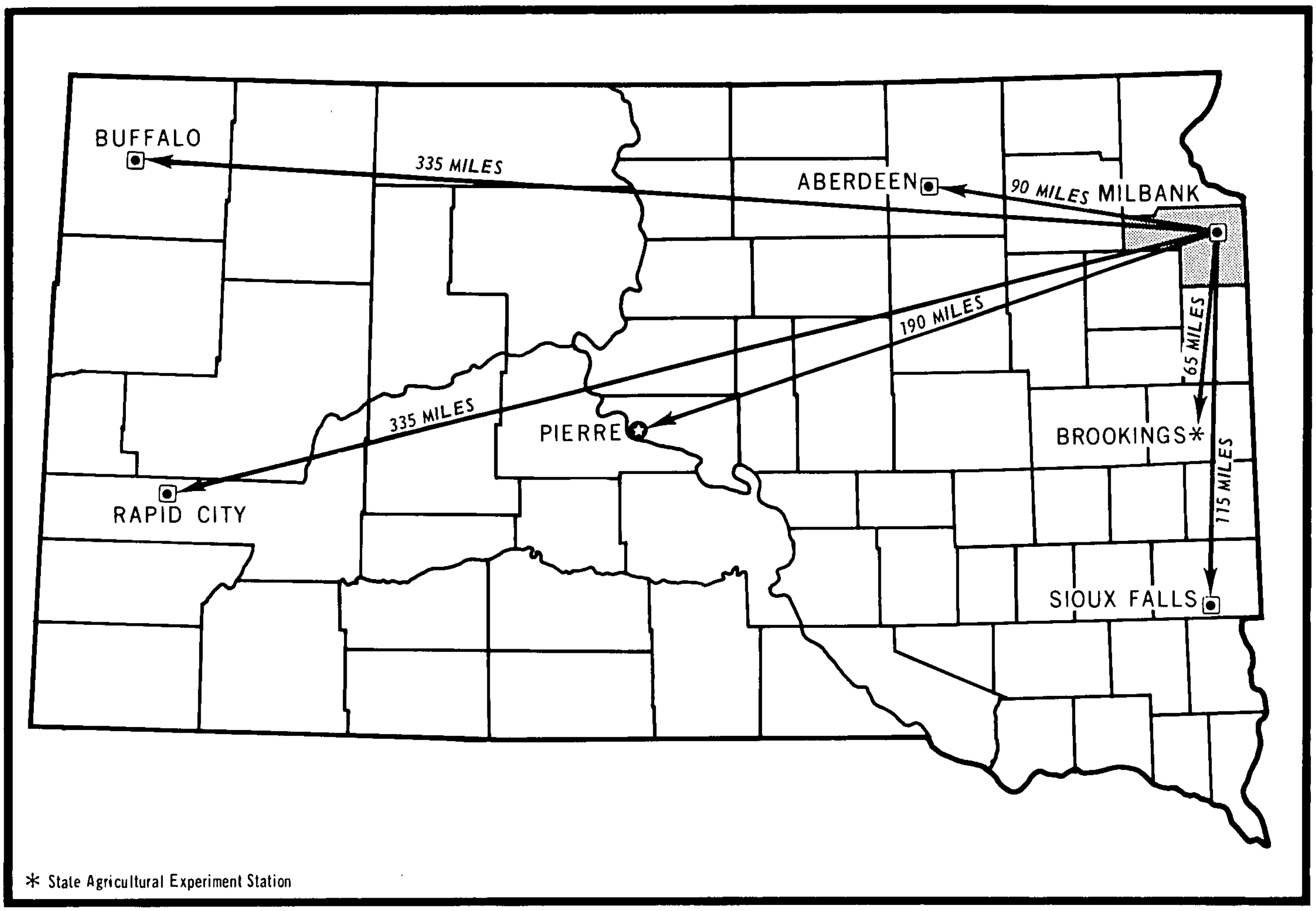
State Conservationist
Soil Conservation Service



Location of Grant County in South Dakota.

Soil Survey of

Grant County, South Dakota

by Kenneth F. Miller, Soil Conservation Service
Soils surveyed by Kenneth F. Miller, Leonard S. Kempf, and
Vernon F. Koopman, Soil Conservation Service

United States Department of Agriculture
Soil Conservation Service
in cooperation with
South Dakota Agricultural Experiment Station

GRANT COUNTY is in the northeastern part of South Dakota. The eastern side of the county borders Minnesota. The land area is about 439,680 acres.

In 1970, according to the U.S. Census of that year (*8*), the population of Grant County was 9,005. Milbank, the county seat, is in the northeastern part of the county and is the largest town. In 1970, the population of Milbank was 3,727. Other towns and villages in the county are Albee, Big Stone City, Labolt, Marvin, Revillo, Stockholm, Strandburg, Troy, and Twin Brooks.

About 68 percent of the county is cropland, and about 25 percent is native grassland. The main crops are corn, spring wheat, oats, flax, and alfalfa. Farming is diversified. Livestock and livestock products are the main sources of farm income. Cash crops also provide income.

General nature of the county

This section gives general information about the climate, physiography and relief, settlement, farming, and natural resources of Grant County.

Climate

Winters in Grant County are cold. Summers are hot, but there are occasional cool spells. In winter, precipitation frequently occurs as snowstorms. During warm months, it occurs mainly as showers. When warm, moist air moves into Grant County from the south, the showers commonly are heavy. Total annual rainfall normally is adequate for corn, soybeans, and small grains.

Table 1 gives data on temperature and precipitation for the survey area, as recorded at Milbank for the period 1951 to 1974. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 16 degrees F, and the average daily minimum temperature is 6 degrees. The lowest temperature on record, which occurred at Milbank on January 21, 1970, is -32 degrees. In summer, the average temperature is 71 degrees, and the average daily maximum temperature is 83 degrees. The highest recorded temperature, which occurred on July 10, 1966, is 108 degrees.

Growing degree days, shown in table 1, are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

Of the total annual precipitation, 17 inches, or 80 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 14 inches. The heaviest 1-day rainfall during the period of record was 3.59 inches at Milbank on July 27, 1963. Thunderstorms occur on about 40 days each year, and most occur in summer.

The average seasonal snowfall is 36 inches. The greatest snow depth at any one time during the period of record was 28 inches. On the average, 36 days have at least 1 inch of snow on the ground, but the number of such days varies greatly from year to year. Several times each winter, storms with snow and high winds bring blizzard conditions to the county.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The percentage of possible sunshine is 75 in summer and 55 in winter. The prevailing wind is from the south-southeast in summer and from the north-northwest in winter. Average windspeed is highest, 14 miles per hour, in April.

Climatic data in this section were specially prepared for the Soil Conservation Service by the National Climatic Center, Asheville, North Carolina.

Physiography and relief

Most of Grant County is on the Coteau Des Prairies, a highland plateau locally known as "the hills." This plateau begins about 4 miles north of Marvin and extends across the county in a southeasterly direction. It is mostly gently undulating to hilly. About half of the area in the eastern part of the county is mainly nearly level to undulating. This area is locally known as "the valley." The Whetstone and Yellow Bank Rivers and their tributaries flow through this area and drain east to the Minnesota River. In the western part of the county, the Big Sioux River drains south to the Missouri River. The elevation in Grant County ranges from about 2,000 feet above sea level near Summit Lake to about 977 feet near Big Stone City.

Settlement

Grant County was established in 1873 by an act of the Dakota Territorial Legislature. It was named after General Ulysses S. Grant. Big Stone City, located at the southern end of Big Stone Lake, became the first county seat in 1878. The county seat was subsequently moved to Milbank, which was founded in 1877.

The earliest known settlement in the county was Inkpa City, which was established in 1865 and later renamed Big Stone City. General settlement took place from 1877 to 1883 during the westward movement of railroads, land speculators, and farmers. The early settlers were principally pioneers from the eastern states and immigrants from Germany and the Scandinavian countries.

In about 1880, the Hastings and Dakota division of the Chicago, Milwaukee, St. Paul, and Pacific Railroad pushed westward across the county through Big Stone City, Milbank, Twin Brooks, and Marvin. Two other railroads, the Burlington Northern and the Minneapolis and St. Louis, crossed the southern part of the county. The Burlington Northern Railroad still serves the towns of Stockholm, Labolt, and Albee. The Minneapolis and St. Louis Railroad once served the towns of Troy, Strandburg, and Revillo, but it is no longer in operation.

In 1890, the population of Grant County was 6,814. By 1920, it had increased to 10,880. Since 1920, the population of Grant County has gradually decreased. It was 10,233 in 1950 and 9,005 in 1970.

Farming

The first settlers in Grant County produced mainly small grains and some livestock. Today, the agriculture in Grant County is a combination of grain farming, livestock raising, and dairy farming. The major crops include corn, oats, spring wheat, flax, and alfalfa. Milk production is also very important in Grant County.

The rougher land in the county is best suited to grazing and to livestock farming. The rest of the land is well suited to general farming of cash grains and cultivated crops. Controlling erosion, conserving water, and maintaining soil tilth and fertility are the main concerns in managing farmland.

Farming is the main occupation in the county, and farms are becoming larger and fewer. In 1974, there were 900 farms of an average size of 450 acres (*4*). About 46,000 acres was used for corn harvested for grain, and 40,200 acres was used for wheat harvested for grain; 54,500 acres was in oats, 23,330 acres in flax seed, 6,800 acres in rye, 3,300 acres in barley, and 8,900 acres in soybeans. Alfalfa for hay was harvested on 38,500 acres, and wild hay was harvested on 16,000 acres. In 1974, there were 64,000 cattle, 16,000 hogs, and 4,500 sheep in the county. About 8,400 of the cattle were milk cows.

Natural resources

Soil is the most important natural resource in Grant County. It is the essential resource for all agricultural enterprises in the county, including livestock grazing, cropping, and dairy farming.

In most of the county, the water supply is adequate for domestic use and for livestock. The underground sources of water are bedrock aquifers and glacial deposit aquifers. The quality of water from bedrock aquifers is variable. In many places, it is undesirable for domestic use. The glacial deposit aquifers supply water of better quality. These glacial deposits are the outwash valleys, sand and gravel lenses, and buried gravel. The feasibility of irrigation depends on the quality and quantity of available water and on the suitability of the soil.

The principal surface water resources are the Whetstone, Yellowbank, and Big Sioux Rivers and their tributaries and the many wetland areas and natural lakes. Some natural lakes and wetlands provide recreation, but surface water is used mainly for watering livestock and for wildlife.

Deposits of sand and gravel are extensive in Grant County. Sand and gravel are used mainly in building and highway construction. Granite is also a major mineral resource. Milbank granite is a high quality, dark to medium red granite that takes a high polish. A number of granite quarries are located east-southeast of Milbank.

Wildlife in the county includes the white tail deer and upland game birds such as pheasant and Hungarian partridge. Fish such as bass, bluegill, northern pike, perch, and walleye are in the lakes and rivers. The many potholes and wetland areas provide habitat for waterfowl.

How this survey was made

Soil scientists made this survey to learn what kinds of soil are in the survey area, where they are, and how they can be used. The soil scientists went into the area knowing they likely would locate many soils they already knew something about and perhaps identify some they had never seen before. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material, which has been changed very little by leaching or by the action of plant roots.

The soil scientists recorded the characteristics of the profiles they studied, and they compared those profiles with others in counties nearby and in places more distant. Thus, through correlation, they classified and named the soils according to nationwide, uniform procedures.

After a guide for classifying and naming the soils was worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, roads, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called soil map units. Some map units are made up of one kind of soil, others are made up of two or more kinds of soil, and a few have little or no soil material at all. Map units are discussed in the sections "General soil map for broad land use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of soils are taken as needed for laboratory measurements and for engineering tests. The soils are field tested, and interpretations of their behavior are modified as necessary during the course of the survey. New interpretations are added to meet local needs, mainly through field observations of different kinds of soil in different uses under different levels of management. Also, data are assembled from other sources, such as test results, records, field experience, and information available from state and local specialists. For example, data on crop yields under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it is readily available to different groups of users, among them farmers, managers of rangeland and woodland, engineers, planners, developers and builders, homebuyers, and those seeking recreation.

General soil map for broad land use planning

The general soil map at the back of this publication shows, in color, soil associations that have a distinct pattern of soils and of relief and drainage. A soil association is a unique natural landscape. Typically, it consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in others but in a different pattern.

The general soil map provides a broad perspective of the soils and landscapes in the survey area. It provides a basis for comparing the potential of large areas for general kinds of land use. Areas that are, for the most part, suited to certain kinds of farming or to other land uses can be identified on the map. Likewise, areas of soils having properties that are distinctly unfavorable for certain land uses can be located.

Because of its small scale, the map does not show the kind of soil at a specific site. Thus, it is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The kinds of soil in any one association differ from place to place in slope, depth, stoniness, drainage, or other characteristics that affect their management.

The soil associations on the general soil map of this county are described on the pages that follow. The names of the associations do not coincide exactly with those in the published surveys of adjacent Codington, Day, and Roberts Counties. This is because of differences in detail of the general soil map and also because of changes in the soil classification system.

Descriptions of soil associations

1. Forman-Aastad-Buse association

Deep, well drained and moderately well drained, nearly level to steep, loamy soils; on uplands

This soil association is on a glacial moraine. Slopes generally are nearly level to hilly; they are steeper along the sides of entrenched drainageways. There are sloughs and closed depressions throughout the association. In some areas, few to many stones are scattered on the ridgetops. In many areas, the drainage pattern is poorly defined. It is well defined in areas of rolling to steep soils along the boundary of the mapped areas where there are entrenched drainageways.

This association makes up about 24 percent of the survey area. It is about 43 percent Forman soils, 16 percent Aastad soils, 14 percent Buse soils, and 27 percent minor soils (fig. 1).

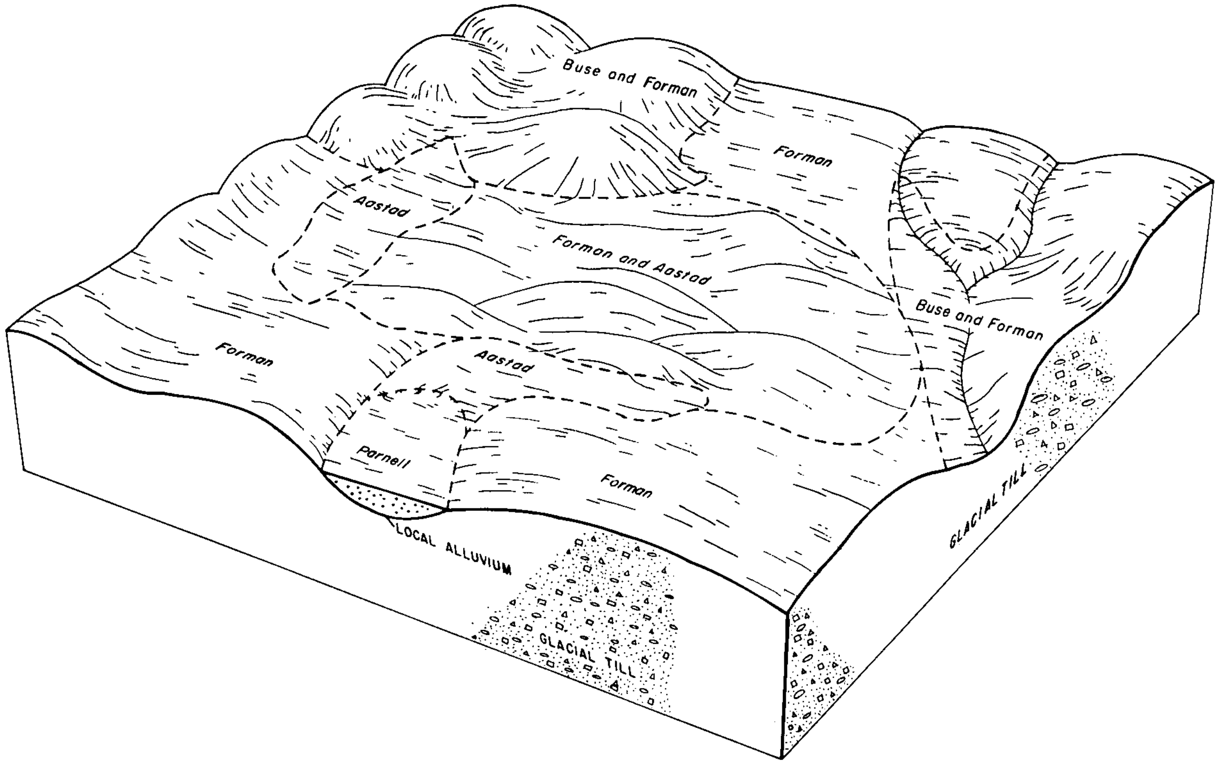


Figure 1.—Pattern of soils and underlying material in the Forman-Aastad-Buse association.

Forman soils are well drained and are on uplands. Slopes are convex and plane and generally are less than 25 percent. The surface layer is dark gray loam. The subsoil is brown and grayish brown clay loam. The underlying material is light brownish gray, calcareous clay loam.

Aastad soils are moderately well drained and are in swales and on the lower part of foot slopes. They are subject to flooding. Slopes are concave and generally are less than 6 percent. The surface layer is dark gray loam. The subsoil is grayish brown, firm clay loam. The underlying material is light yellowish brown, calcareous loam.

Buse soils are well drained and are on ridges and steep sides slopes. Slopes are convex and generally are less than 40 percent. The surface layer is dark gray loam. The underlying material is light brownish gray and light gray, calcareous clay loam.

The minor soils in this association are the Barnes soils on side slopes; the Renshaw and Sioux soils, which are underlain by sand and gravel; the poorly drained Parnell and Tonka soils in depressions; and the moderately well drained LaDelle soils on bottom lands along drainageways.

Fertility in the Aastad and Forman soils is medium or high, and in the Buse soils it is low or medium. Permeability in the Forman soils is moderate in the subsoil and moderately slow in the underlying material, and in the Buse and Aastad soils it is moderately slow. The available water capacity is high.

About 42 percent of this association is used for crops and as tame pasture and hayland. The main crops are corn, small grains, and alfalfa. The rest of the association is in native grass and is used as pasture and for hay. If the soils are used for crops, the main concerns of management are controlling erosion in sloping areas, conserving moisture, and maintaining tilth and fertility. Terracing and contouring are not feasible in some areas because of the short, irregular slopes and the small sloughs and depressions. In some areas, the steep slopes, cobblestones, and stones impair tillage and haying operations.

The nearly level to undulating soils of this association generally have good potential for crops and for use as tame pasture and hayland. The major soils have good potential for the development of habitat for openland and rangeland wildlife. Forman and Aastad soils have

good potential for windbreaks and environmental plantings, and Buse soils have poor potential. Forman soils have fair potential for most building site development and sanitary facilities. Aastad soils have poor potential for most building site development and sanitary facilities because flooding is a hazard. Buse soils have fair or poor potential for building site development and sanitary facilities because of the steepness of slopes.

2. Peever association

Deep, well drained, nearly level to moderately sloping, loamy soils; on uplands

This soil association is on a glacial till plain that is characterized by broad flats, gentle rises, sloping areas, swales, and closed depressions. Slopes mainly are nearly level to moderately sloping and gently rolling, but in places they are strongly sloping to rolling. Areas of steeper soils are along some drainageways. There are small sloughs and depressions throughout this association. The drainage pattern is well defined along the larger drainageways; it is poorly defined in some areas where small drainageways terminate in the small sloughs and depressions.

This association makes up about 28 percent of the county. It is about 53 percent Peever soils and 47 percent minor soils (fig. 2).

Peever soils are well drained and are nearly level to moderately sloping. Slopes generally are less than 9 percent. The surface layer is dark gray clay loam. The subsoil is dark grayish brown, dark gray, grayish brown, and light brownish gray, firm clay loam. The underlying material is light brownish gray, calcareous clay loam.

The minor soils in this association are the calcareous Hattie soils on some ridges and on side slopes of entrenched drainageways; the moderately well drained Cavour soils, which are intermingled with Peever soils; the poorly drained Parnell and Tonka soils in closed depressions; and the moderately well drained LaDelle, Overly, and Swenoda soils on bottom lands and in swales.

Fertility is medium or high. The available water capacity is moderate or high. Permeability is moderately slow or slow. The shrink-swell potential is high in the subsoil and in the underlying material. Peever soils are difficult to till, and tilth deteriorates if these soils are cultivated when wet.

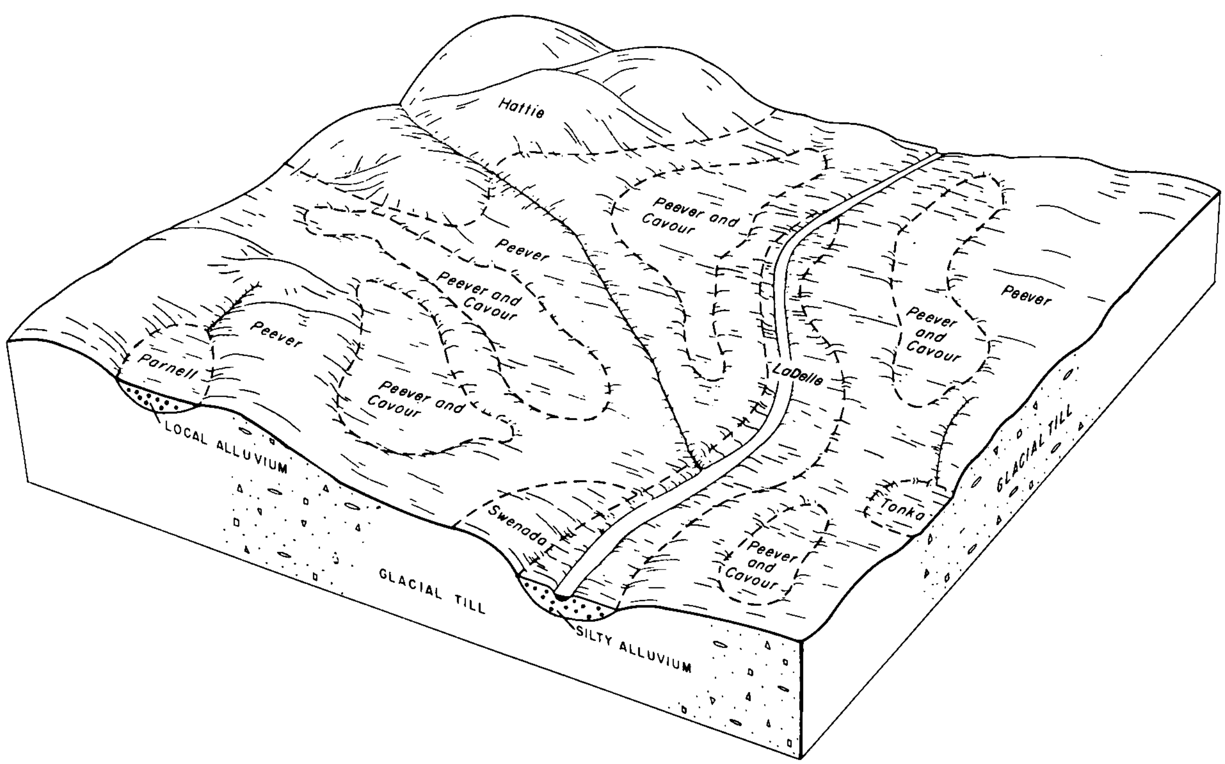


Figure 2.—Pattern of soils and underlying material in the Peever association.

About 78 percent of this association is used for crops and as tame pasture or hayland. The main crops are corn, small grains, and alfalfa. The rest of the association, which consists of steeper soils and poorly drained and very poorly drained soils, is in native grass and is used as rangeland. If these soils are used for crops, the main concerns of management are controlling erosion on the moderately sloping soils, maintaining tilth and fertility, and controlling soil blowing.

This association has good potential for crops; for use as tame pasture, hayland, and rangeland; and for the development of habitat for rangeland wildlife. It has fair potential for windbreaks and environmental plantings and for the development of habitat for openland wildlife. This association has poor potential for building site development and sanitary facilities.

3. Forman-Aastad association

Deep, well drained and moderately well drained, nearly level to strongly sloping, loamy soils; on uplands

This soil association is on a glacial till plain. The landscape consists of knolls and sloping areas that rise above the bottom lands, swales, and closed depressions. Slopes mainly are nearly level to undulating, but they are steeper in some narrow areas along the side slopes of entrenched drainageways. There are many small depressions and a few sloughs throughout this association. The drainage pattern is well defined along the rivers and larger drainageways; it is poorly defined in areas where small drainageways terminate in the small sloughs and depressions.

This association makes up about 8 percent of the county. It is about 38 percent Forman soils, 14 percent Aastad soils, and 48 percent minor soils.

Forman soils are well drained and are on uplands. Slopes are convex or plane and generally are less than 15 percent. The surface layer is dark gray loam. The subsoil is brown and grayish brown clay loam. The underlying material is light brownish gray, calcareous clay loam.

Aastad soils are moderately well drained and are in swales and on the lower part of foot slopes. They are subject to flooding. Slopes are concave and generally are less than 6 percent. The surface layer is dark gray loam. The subsoil is grayish brown, firm clay loam. The underlying material is light yellowish brown, calcareous loam.

The minor soils in this association are the calcareous Buse soils on knolls and ridges and on side slopes of entrenched drainageways; the Fordville and Egeland soils, which are underlain by sand and gravel and by loamy fine sand; the moderately well drained LaDelle soils and the poorly drained Dovray, Ludden, and Playmoor soils on bottom lands; and the very poorly drained Parnell soils and the poorly drained Tonka soils in depressions.

Permeability in the Forman soils is moderate in the subsoil and moderately slow in the underlying material, and in the Aastad soils it is moderately slow. The available water capacity of the Forman and Aastad soils is high. Fertility is medium or high.

About 78 percent of this association is used for crops and as tame pasture and hayland. The main crops are corn, small grain, and alfalfa. Some steeper soils along the larger creeks and drainageways and some poorly drained and very poorly drained minor soils on bottom lands and in closed depressions are in native grass and are used for grazing. If the soils in this association are used for crops, the main concerns of management are controlling erosion on the sloping soils, conserving moisture, and maintaining tilth and fertility.

This association generally has good potential for crops; for use as tame pasture, hayland, and rangeland; for windbreaks and environmental plantings; and for the development of habitat for openland and rangeland wildlife. Forman soils generally have fair potential for most building site development and sanitary facilities. Aastad soils have poor potential for building site development and sanitary facilities because flooding is a hazard.

4. Heimdal-Svea-Sisseton association

Deep, well drained and moderately well drained, nearly level to steep, loamy soils; on uplands

This soil association is on a glacial plain that is characterized by gentle rises, light-colored knolls, swales, and closed depressions. Slopes mainly are nearly level to strongly sloping and rolling, but they are steeper in areas adjacent to Big Stone Lake and on the side slopes of entrenched drainageways. Few to many stones are on the surface of some steeper soils. The drainage pattern is well defined along the larger drainageways; it is poorly defined in some areas where small drainageways terminate in the sloughs and depressions.

This association makes up about 9 percent of the county. It is about 42 percent Heimdal soils, 15 percent Svea soils, 14 percent Sisseton soils, and 29 percent minor soils (fig. 3).

Heimdal soils are well drained and are on uplands. Slopes are convex or plane and generally are less than 15 percent. The surface layer is dark gray loam. The subsoil is dark grayish brown and brown, very friable loam. The underlying material is light gray and pale yellow, calcareous loam.

Svea soils are moderately well drained and are in swales and on the lower part of foot slopes. Slopes are concave and generally are less than 6 percent. The surface layer is dark gray loam. The subsoil is dark grayish brown and grayish brown, friable loam. The underlying material is light brownish gray, calcareous loam that is stratified with sandy loam in the lower part.

Sisseton soils are well drained and are on convex knolls and ridges. Slopes generally are less than 15 percent but range to as much as 40 percent in some

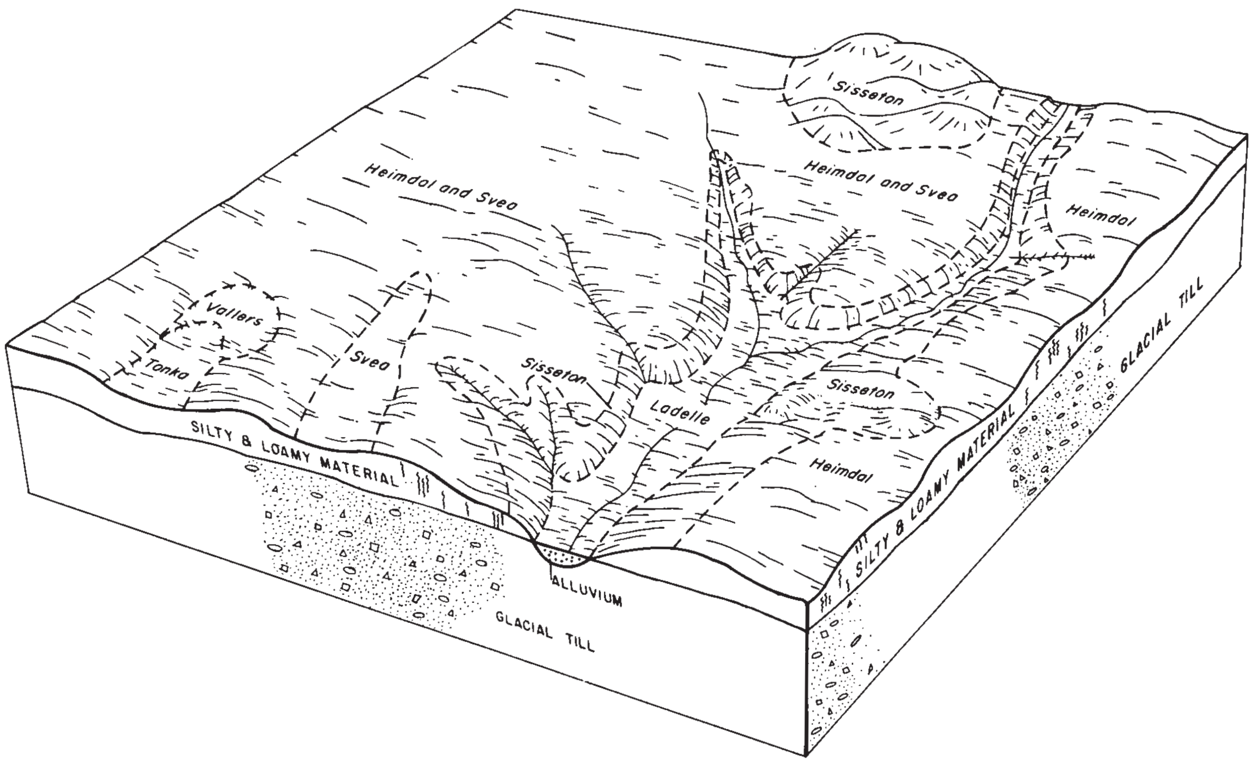


Figure 3.—Pattern of soils and underlying material in the Heimdal-Svea-Sisseton association.

areas. The surface layer is light brownish gray, calcareous loam. The subsoil is light gray and pale yellow, very friable, calcareous loam. The underlying material is pale yellow, calcareous loam.

The minor soils in this association are the somewhat poorly drained Bearden soils on flats and adjacent to depressions; the well drained Barnes, Forman, and Poinsett soils, which are intermingled with Heimdal soils; the poorly drained Tonka soils in depressions; the poorly drained Vallers soils on flats and in low areas adjacent to potholes; and the moderately well drained LaDelle soils on bottom lands.

Fertility in the Heimdal and Svea soils is medium or high, and in the Sisseton soils it is low. Permeability in the Heimdal and Sisseton soils is moderate. In the Svea soils, permeability is moderate in the subsoil and moderately slow in the underlying material. The available water capacity is high in all of these soils.

About 72 percent of this association is used for crops and as tame pasture and hayland. The main crops are corn, small grain, and alfalfa. Some of the steeper soils along the larger drainageways and lakes, the stony soils, and the poorly drained minor soils on bottom lands and in closed depressions are in native grass and are used for grazing. If the soils in this association are used for crops, the main concerns of management are controlling erosion on the undulating and sloping soils, conserving moisture, and maintaining fertility.

This association generally has good potential for crops; for use as tame pasture, hayland, and rangeland; for windbreaks and environmental plantings; and for the development of habitat for openland and rangeland wildlife. The Sisseton soils are better suited to small grains, alfalfa, and tame grasses than to corn. The steeper Sisseton soils have poor potential for most agricultural uses. The soils in this association have fair potential for building site development and sanitary facilities.

5. Vienna-Lismore association

Deep, well drained and moderately well drained, nearly level to strongly sloping, silty soils; on uplands

This soil association is on a glacial till plain. The landscape consists of gentle rises that have long, smooth slopes leading to small drainageways. Slopes mainly are nearly level to moderately sloping, but they are strongly sloping in areas adjacent to entrenched drainageways. In

places, a few closed depressions dot the landscape. The drainage pattern is well defined.

This association makes up about 11 percent of the county. It is about 55 percent Vienna soils, 25 percent Lismore soils, and 20 percent minor soils.

Vienna soils are well drained and are on flats, gentle rises, and long, smooth slopes. Slopes generally are less than 15 percent. The surface layer is dark gray silt loam. The subsoil is dark grayish brown, friable silt loam in the upper part and grayish brown and light yellowish brown, calcareous clay loam in the lower part. The underlying material is pale yellow, calcareous loam.

Lismore soils are moderately well drained and are on foot slopes and in swales. They are subject to flooding. Slopes generally are less than 6 percent. The surface layer is dark gray silt loam. The subsoil is gray, friable silt loam in the upper part and brown and light olive brown, friable clay loam in the lower part. The underlying material is light yellowish brown, calcareous loam.

The minor soils in this association are the moderately well drained Brookings soils in swales; the calcareous Buse soils on some knolls and ridges; the well drained Barnes and Forman soils in areas where glacial till is exposed; the Fordville and Renshaw soils, which are underlain by sand and gravel; the poorly drained Parnell and Tonka soils in depressions; and the poorly drained Vallers soils on low flats and in drainageways.

Fertility of the Vienna and Lismore soils is medium or high. The available water capacity is high. Permeability is moderate in the subsoil and moderately slow in the underlying material.

About 75 percent of this association is used for crops and as tame pasture and hayland. The main crops are small grains, corn, sunflowers, and alfalfa. Some areas of the steeper and hilly soils and many areas of the poorly drained minor soils on bottom lands and in closed depressions are in native grass and are used for grazing. If the soils in this association are used for crops, the main concerns of management are controlling erosion on the sloping soils, conserving moisture, and maintaining fertility.

This association generally has good potential for crops; for use as tame pasture, hayland, and rangeland; for windbreaks and environmental plantings; and for the development of habitat for openland and rangeland wildlife. It has fair to poor potential for building site development and sanitary facilities.

6. Renshaw-Fordville-Divide association

Somewhat excessively drained to somewhat poorly drained, nearly level to moderately steep, loamy soils that are shallow or moderately deep over sand and gravel; on uplands and terraces

This soil association is on glacial outwash plains and glacial moraines. Slopes mainly are nearly level to gently undulating and sloping, but they are steeper on the glacial moraines and on the side slopes of drainageways. In some areas, the drainage pattern is poorly defined; it is well defined along the larger drainageways.

This association makes up about 12 percent of the county. It is about 36 percent Renshaw soils, 11 percent Fordville soils, 10 percent Divide soils, and 43 percent minor soils (fig. 4).

Renshaw soils are somewhat excessively drained and are on uplands. Slopes are convex and plane and generally are less than 15 percent; they range to as much as 25 percent in some areas. Renshaw soils are shallow to sand and gravel. The surface layer is dark gray loam. The subsoil is dark gray, brown, and grayish brown, very friable loam. The underlying material is grayish brown and brown, calcareous sand and gravel.

Fordville soils are well drained and are on uplands. Slopes are convex and plane and are less than 6 percent. Fordville soils are moderately deep to sand and gravel. The surface layer is dark gray loam. The subsoil is dark gray, grayish brown, and light olive brown, friable loam. The underlying material is grayish brown and light brownish gray sand and gravel.

Divide soils are moderately well drained or somewhat poorly drained and are in swales or in flat areas. Slopes are less than 2 percent. Divide soils are moderately deep to sand and gravel. The surface layer is very dark gray and gray, calcareous loam. The underlying material is light brownish gray, calcareous loam in the upper part; below that, it is grayish brown, calcareous loamy sand underlain by light brownish gray, calcareous sand and gravel.

The minor soils in this association are the somewhat excessively drained Arvilla soils, which are intermingled with Renshaw soils; the well drained Egeland soils in areas of sandy glacial outwash; the well drained Estelline soils, which are intermingled with Fordville and Renshaw soils; the poorly drained Marysland soils on broad flats; the very poorly drained Rauville soils on low bottom lands and along drainageways; the well drained Rentill soils, which are intermingled with Renshaw soils; and the excessively drained Sioux soils on knolls and ridges.

Fertility in the Renshaw soils is low or medium, and in the Fordville and Divide soils it is medium. Permeability in the Renshaw soils is moderately rapid in the upper part and rapid in the lower part; in the Fordville soils it is moderate in the upper part and rapid in the lower part; and in the Divide soils, permeability is moderate in the upper part and very rapid in the lower part. The available water capacity in the Renshaw soils is low, and in the Fordville and Divide soils it is low or moderate.

About 67 percent of this association is used for crops and as tame pasture or hayland. The main crops are

corn, small grains, and alfalfa. Some of the steeper soils on the glacial moraine and some soils bordering drainageways are in native grass and are used for grazing. The soils in this association are droughty. If these soils are used for crops, controlling erosion and conserving moisture are the main concerns of management.

The soils in this association that have less than 6 percent slopes generally have fair potential for crops and for use as tame pasture and hayland, and the soils that have more than 6 percent slopes generally have poor potential for these uses. The soils in this association are better suited to small grains, alfalfa, and tame grasses than to corn. Fordville and Divide soils have fair potential for windbreaks and environmental plantings, and Renshaw soils have poor potential. Renshaw and Fordville soils generally have good potential for building site development and poor potential for sanitary facilities. Divide soils have poor potential for building site development and sanitary facilities because of wetness.

7. LaDelle-Dovray-Playmoor association

Deep, moderately well drained and poorly drained, level and nearly level, silty and clayey soils; on flood plains, low terraces, and upland flats

This soil association is on broad flats adjacent to entrenched drainageways and rivers. Slopes mainly are level to nearly level but are steeper along drainage channels.

This association makes up about 8 percent of the county. It is about 49 percent LaDelle soils, 16 percent Dovray soils, 10 percent Playmoor soils, and 25 percent minor soils.

LaDelle soils are moderately well drained and are on low stream terraces. The surface layer is dark gray silt loam. The underlying material is gray, calcareous silty clay loam.

Dovray soils are poorly drained and are on low upland flats. The surface layer is very dark gray and dark gray silty clay. The subsoil is dark gray and olive gray, very firm silty clay. The underlying material is gray, calcareous clay loam.

Playmoor soils are poorly drained and are on low flood plains. The surface layer is very dark gray to gray, calcareous silty clay loam. The underlying material is gray, calcareous silty clay loam.

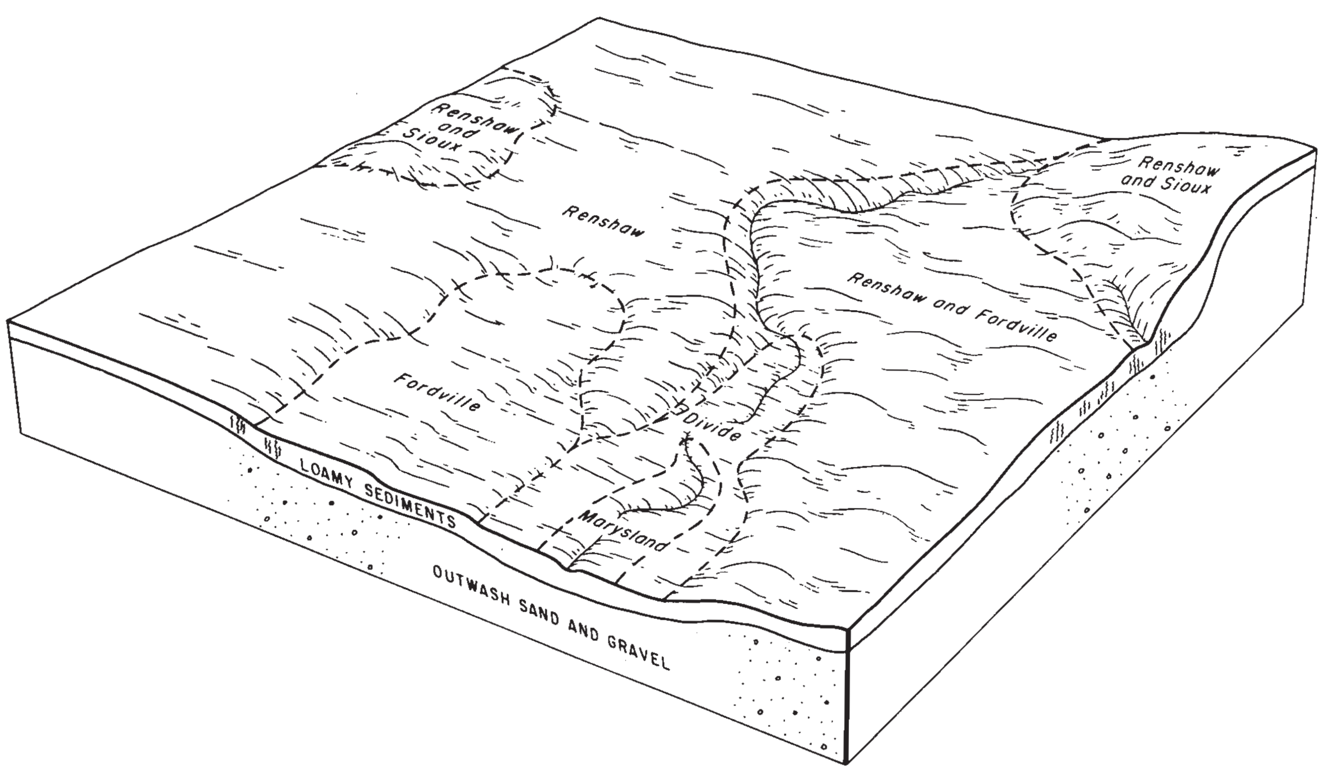


Figure 4.—Pattern of soils and underlying material in the Renshaw-Fordville-Divide association.

The minor soils in this association are the calcareous Buse soils on side slopes of some entrenched drainageways; the well drained Forman and Peever soils in isolated high areas; the poorly drained Ludden soils on low flats; the poorly drained Marysland soils and the somewhat excessively drained Renshaw soils, which are underlain by sand and gravel; the moderately well drained Overly soils on terraces; and the very poorly drained Rauville soils in low areas along drainageways.

Fertility in the LaDelle and Dovray soils is medium or high, and in the Playmoor soils it is medium. Permeability is moderate in the LaDelle soils, very slow in the Dovray soils, and moderately slow in the Playmoor soils. The available water capacity in the LaDelle and Playmoor soils is high, and in the Dovray soils it is low or moderate. All of these soils are subject to flooding.

About 70 percent of this association is used for crops and as tame pasture and hayland. The main crops are corn, small grains, and alfalfa. In some areas, the poorly drained Ludden and Playmoor soils and the steep soils bordering drainageways are in native grass and are used for grazing. Wetness is the main concern of management. Maintaining fertility and tilth and improving the rate of water intake are other management concerns.

The LaDelle and Dovray soils have good potential for crops; for use as tame pasture, hayland, and rangeland; for windbreaks and environmental plantings; and for the development of habitat for openland wildlife. The Playmoor soils generally have poor potential for these uses. All of these soils have poor potential for building site development and most sanitary facilities.

Soil maps for detailed planning

The map units shown on the detailed soil maps at the back of this publication represent the kinds of soil in the survey area. They are described in this section. The descriptions together with the soil maps can be useful in determining the potential of a soil and in managing it for food and fiber production; in planning land use and developing soil resources; and in enhancing, protecting, and preserving the environment. More information for each map unit, or soil, is given in the section "Use and management of the soils."

Preceding the name of each map unit is the symbol that identifies the soil on the detailed soil maps. Each soil description includes general facts about the soil and a brief description of the soil profile. In each description, the principal hazards and limitations are indicated, and the management concerns and practices needed are discussed.

The map units on the detailed soil maps represent an area on the landscape made up mostly of the soil or soils for which the unit is named. Most of the delineations shown on the detailed soil map are phases of soil series.

Soils that have profiles that are almost alike make up a *soil series*. Except for allowable differences in texture of the surface layer or of the underlying substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement in the profile. A soil series commonly is named for a town or geographic feature near the place where a soil of that series was first observed and mapped. The Peever series, for example, was named for the town of Peever in Roberts County.

Soils of one series can differ in texture of the surface layer or in the underlying substratum and in slope, erosion, stoniness, salinity, wetness, or other characteristics that affect their use. On the basis of such differences, a soil series is divided into phases. The name of a *soil phase* commonly indicates a feature that affects use or management. For example, Peever clay loam, 2 to 6 percent slopes, is one of several phases within the Peever series.

Some map units are made up of two or more dominant kinds of soil. Such map units are called soil complexes.

A *soil complex* consists of areas of two or more soils that are so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area includes some of each of the two or more dominant soils, and the pattern and proportion are somewhat similar in all areas. The Aastad-Flom complex is an example.

Most map units include small, scattered areas of soils other than those that appear in the name of the map unit. Some of these soils have properties that differ substantially from those of the dominant soil or soils and thus could significantly affect use and management of the map unit. These soils are described in the description of each map unit. Some of the more unusual or strongly contrasting soils that are included are identified by a special symbol on the soil map.

Most mapped areas include places that have little or no soil material and support little or no vegetation. Such places are called *miscellaneous areas*; they are delineated on the soil map and given descriptive names. Pits, gravel is an example. Some of these areas are too small to be delineated and are identified by a special symbol on the soil map.

The acreage and proportionate extent of each map unit are given in table 4, and additional information on properties, limitations, capabilities, and potentials for many soil uses is given for each kind of soil in other tables in this survey. (See "Summary of tables.") Many of the terms used in describing soils are defined in the Glossary.

The names of some map units on the detailed soil maps do not fully agree with those in the published survey of adjacent Codington, Day, and Roberts Counties. This is due to changes in the application of the soil classification system.

Soil descriptions

Aa—Aastad-Flom complex. This complex consists of deep, nearly level, moderately well drained and poorly drained soils in swales and on foot slopes on uplands. Some areas are dissected by shallow drainageways. The areas of this map unit range from 5 to 20 acres in size. They are 55 to 65 percent Aastad soil and 25 to 30 percent Flom soil. The Aastad soil is on the lower part of side slopes and the upper part of swales. It is subject to frequent flooding of very brief duration. The Flom soil is on the lower part of swales and in shallow drainageways. It is subject to frequent flooding of brief duration. These soils are so intermingled or the areas of each soil are so small in size that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Aastad soil is about 17 inches thick. In the upper 6 inches, it is dark gray loam, and in the lower part, it is dark gray clay loam. The subsoil is grayish brown, firm clay loam about 12 inches thick. The underlying material, to a depth of 60 inches, is light yellowish brown, calcareous loam. In places, the upper part of the surface layer is silt loam. In some areas, lime is at a greater depth.

Typically, the surface layer of the Flom soil is about 17 inches thick. The upper part is very dark gray clay loam about 9 inches thick, and the lower part is dark gray clay loam about 8 inches thick. The subsoil is grayish brown, friable clay loam about 8 inches thick. The underlying material, to a depth of 60 inches, is olive gray and light olive gray, calcareous clay loam. In places, accumulations of carbonates are at a lesser depth, and salts are in the lower part of the surface layer. In some areas, the upper part of the surface layer is thicker than is typical.

Included in mapping are small areas of the well drained Forman soils and the poorly drained Tonka and Vallers soils. These soils make up less than 10 percent of any one mapped area. The Forman soils are on slight rises. The Tonka soils are in shallow depressions. The Vallers soils are at the edge of depressions.

Permeability in the Aastad and Flom soils is moderately slow. The available water capacity is high. Runoff is slow. The organic matter content is high, and fertility is medium or high. The shrink-swell potential is moderate in the subsoil and underlying material. The Aastad soil has a water table between depths of 3 and 6 feet for short periods in spring. The Flom soil has a water table between depths of 1 and 3 feet and is wet for short periods in spring.

In most areas, these soils are used for farming. In some areas, they are in native grass and are used for grazing and hay. These soils have good potential for crops; for use as tame pasture, hayland, and rangeland; for windbreaks and environmental plantings; and for the development of habitat for openland wildlife. They have fair potential for the development of habitat for rangeland wildlife. These soils have poor potential for building site development and sanitary facilities.

These soils are suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. The main concern of management is maintaining fertility and tilth. Wetness also is a concern. Planting and harvesting commonly are delayed in wet periods. Crop residue management and legumes and grasses in the cropping system help to maintain fertility and tilth and to increase water infiltration. Controlling runoff from adjacent soils helps to prevent excessive flooding.

These soils are suited to use as tame pasture and hayland. Overgrazing or grazing when the soil is too wet can cause surface compaction and poor tilth. Stocking at the proper rate, rotating pasture, deferring grazing, and restricting use in wet periods help to keep pasture and soil in good condition.

These soils are well suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs survive and grow well because the supply of available moisture is good. Competing vegetation can be controlled through good site preparation, cultivation, and the use of herbicides.

If buildings are constructed on these soils, runoff should be diverted from the building site. Foundations and footings should be reinforced to prevent structural damage by the shrinking and swelling of the soil. Roads should be constructed on raised and well compacted material, and drainage should be provided to help prevent damage to the road by frost action and by the shrinking and swelling of the soil. The moderately slow permeability and flooding are problems if these soils are used as septic tank absorption fields. If septic tank absorption fields are needed, they should be installed on adjacent soils. Sewage lagoons can be constructed on these soils, but the pollution of ground water is a hazard in areas of the Flom soil.

The Aastad soil is in capability unit I-3, Overflow range site; the Flom soil is in capability unit IIw-3, Subirrigated range site.

AbA—Arvilla sandy loam, 0 to 2 percent slopes. This is a nearly level, somewhat excessively drained soil on broad, smooth outwash plains on uplands. It is shallow to sand and gravel. The areas are irregular in shape and range from 4 to 120 acres in size.

Typically, the surface layer is dark gray sandy loam about 7 inches thick. The subsoil is dark grayish brown, very friable sandy loam about 9 inches thick. The underlying material, to a depth of 60 inches, is brown and pale brown sand and gravel. In places, the subsoil has more silt and clay than is typical.

Included in mapping and making up about 10 percent of any one mapped area are small areas of the well drained Fordville soils. These soils have more silt and clay in the upper part and are deeper to sand and gravel than this Arvilla soil.

Permeability is moderately rapid in the upper part of the soil and rapid in the underlying sand and gravel. The available water capacity is low. The organic matter content is moderate, and fertility is low or medium. Runoff is slow.

In most areas, this soil is used for farming. In a few areas, it is in native grass and is used for grazing and hay. This soil has fair potential for cultivated crops, for use as tame pasture and hayland, for windbreaks and environmental plantings, and for the development of habitat for openland wildlife. It has poor potential for use as rangeland and for the development of habitat for rangeland wildlife. This soil has good potential for building site development. It has poor potential for most sanitary facilities.

This soil is suited to corn, soybeans, and small grains; however, yields are low because the available water capacity is low. This soil is better suited to crops that mature early than to late-maturing crops. It is suited to sunflowers and to grasses and legumes for hay and pasture. If this soil is used for crops, controlling soil blowing and conserving moisture are the main management concerns. Minimum tillage and stripcropping help to conserve moisture and to control soil blowing. The use of grasses and legumes in the cropping system and the use of green manure crops help to maintain fertility and the organic matter content.

If this soil is used as tame pasture and hayland, the main concerns of management are maintaining an adequate vegetative cover and conserving moisture. Overgrazing pasture reduces the vegetative cover and the stand of desirable grasses. Reseeding adapted grasses, rotating pasture, stocking at the proper rate, and restricting use in droughty periods help to keep pasture and soil in good condition.

This soil is suited to use as sites for windbreaks and environmental plantings; however, trees are difficult to establish, and their growth is slow. Drought-tolerant trees and shrubs should be selected. The survival and growth rates of trees and shrubs can be improved through good site preparation, watering, and controlling competing vegetation.

This soil has slight limitations to building site development; however, the caving or sloughing of walls in shallow excavations is a hazard. This soil has few limitations to use as sites for local roads and streets; however, borrow areas are subject to soil blowing and should be reseeded to adapted grasses. This soil is suited to use as septic tank absorption fields; however, the pollution of ground water is a hazard. This soil generally is not suitable for sewage lagoons because effluent can seep through the underlying sand and gravel and pollute ground water.

Capability unit IIIs-1; Shallow to Gravel range site.

AbB—Arvilla sandy loam, 2 to 6 percent slopes. This is a gently sloping and gently undulating, somewhat excessively drained soil that is shallow over sand and gravel. It is on upland knolls and side slopes. Some areas are dissected by shallow drainageways. The areas are irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is dark gray sandy loam about 7 inches thick. The subsoil is dark grayish brown, very friable sandy loam about 9 inches thick. The underlying material, to a depth of 60 inches, is brown and pale brown sand and gravel. In areas where this soil is on foot slopes, the surface layer and subsoil are thicker than is typical. In areas where this soil is eroded, the surface layer is thinner. In some places, the subsoil has more silt and clay than is typical.

Included in mapping and making up about 10 percent of any one mapped area are small areas of the well drained Fordville soils. Fordville soils have more silt and clay in the upper part and are deeper to sand and gravel than this Arvilla soil.

Permeability is moderately rapid in the upper part of the soil and rapid in the underlying sand and gravel. The available water capacity is low. The organic matter content is moderate, and fertility is low or medium. Runoff is slow.

In most areas, this soil is used for farming. In a few areas, it is in native grass and is used for grazing and hay. This soil has fair potential for crops, for use as tame pasture and hayland, and for windbreaks and environmental plantings. It has poor potential for use as rangeland and for the development of habitat for openland and rangeland wildlife. This soil has good potential for building site development. It has poor potential for most sanitary facilities.

This soil is better suited to crops that mature early than to row crops. It is suited to sunflowers and to grasses and legumes for hay and pasture. If this soil is used for crops, controlling soil blowing and conserving moisture are the main management concerns. Minimum tillage and stripcropping help to conserve moisture and to control soil blowing. The use of grasses and legumes in the cropping system and the use of green manure crops help to maintain fertility and the organic matter content.

Using this soil as tame pasture and hayland is effective in controlling soil blowing and conserving moisture. Rotating pasture, stocking at the proper rate, and restricting use in droughty periods help to control soil blowing.

This soil is suited to use as sites for windbreaks and environmental plantings; however, plantings are difficult to establish and the growth rate is slow. Drought-tolerant trees and shrubs should be selected. The survival and growth rates of trees and shrubs can be improved through good site preparation, by watering, and by controlling the competing vegetation.

This soil has slight limitations to use as sites for buildings; however, the caving or sloughing of walls in shal-

low excavations is a hazard. This soil has few limitations to use as sites for local roads and streets; however, borrow areas are subject to soil blowing and should be reseeded to adapted grasses. This soil is suited to use as septic tank absorption fields; however, the pollution of ground water is a hazard. This soil generally is not suitable for sewage lagoons because effluent can seep through the underlying sand and gravel and pollute ground water.

Capability unit IVs-2; Shallow to Gravel range site.

AbC—Arvilla sandy loam, 6 to 9 percent slopes. This is a moderately sloping and gently rolling, somewhat excessively drained soil on upland ridges and side slopes. Slopes generally are short and irregular. In some areas, a few stones are on the ridgetops. This soil is shallow over sand and gravel. The areas are irregular in shape and range from 4 to 60 acres in size.

Typically, the surface layer is dark gray sandy loam about 7 inches thick. The subsoil is dark grayish brown, very friable sandy loam about 9 inches thick. The underlying material, to a depth of 60 inches, is brown and pale brown sand and gravel. In areas where this soil is eroded, the surface layer is thinner than is typical and, in places, has been mixed with material from the subsoil by plowing. In places, the subsoil has more silt and clay than is typical.

Included in mapping are small areas of Fordville and Sioux soils. Fordville soils have more silt and clay in the upper part than this Arvilla soil. They are on foot slopes and in swales. Sioux soils are on ridgetops and have gravel within a depth of 14 inches.

Permeability is moderately rapid in the upper part of the soil and rapid in the underlying sand and gravel. The available water capacity is low. The organic matter content is moderate, and fertility is low or medium.

In most areas, this soil is in native or tame grasses and is used for grazing or hay. This soil has fair potential for crops, for tame pasture and hay, and for windbreaks and environmental plantings. It has poor potential for use as rangeland and for the development of habitat for openland and rangeland wildlife. This soil has good potential for building site development. It has poor potential for most sanitary facilities.

This soil is better suited to use as tame pasture and hayland than to row crops. The main concerns of management are controlling soil blowing and conserving moisture. Maintaining a good vegetative cover helps to control soil blowing and to conserve moisture. Reseeding adapted grasses, rotating pasture, stocking at the proper rate, and restricting grazing in droughty periods help to keep pasture and soil in good condition. If this soil is used for crops, water erosion and soil blowing are severe hazards. Minimum tillage helps to conserve moisture and to control water erosion and soil blowing.

This soil is suited to use as sites for windbreaks and environmental plantings; however, trees are difficult to establish and their growth rate is slow. Drought-tolerant trees and shrubs should be selected. The survival and growth rates of trees and shrubs can be improved through good site preparation, by watering, and by controlling the competing vegetation.

This soil has slight limitations to use as sites for buildings. However, the caving or sloughing of walls in shallow excavations is a hazard. In places where the slopes are moderate, the surface needs to be shaped for building site development. This soil has few limitations to use as sites for local roads and streets; however, borrow areas are subject to soil blowing and should be reseeded to adapted grasses. This soil is suited to use as sites for septic tank absorption fields; however, the pollution of ground water is a hazard. This soil generally is not suitable for sewage lagoons because effluent can seep through the underlying sand and gravel and pollute ground water and because the moderate slopes require considerable shaping.

Capability unit IVe-4; Shallow to Gravel range site.

BaE—Barnes-Buse extremely stony loams, 9 to 40 percent slopes. These are deep, well drained, strongly sloping to steep, extremely stony soils on upland knolls, ridges, and side slopes. In some areas, mainly in areas of the Buse soil, surface stones are 1 to 5 feet apart. In most places, the stones are more than 10 inches in diameter. A few large boulders are in some areas. Shallow depressions are in a few areas, and some areas are dissected by shallow drainageways. The areas of this map unit are irregular in shape and range from 4 to 150 acres in size. They are 45 to 55 percent Barnes soil and 25 to 35 percent Buse soil. The Barnes soil is on side slopes. The Buse soil is on the higher part of knolls and ridges. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Barnes soil is dark gray extremely stony loam about 5 inches thick. The subsoil is dark grayish brown, friable loam about 8 inches thick. The underlying material, to a depth of 60 inches, is grayish brown and pale yellow, calcareous loam. In areas where this soil is eroded, the surface layer is thinner than is typical.

Typically, the surface layer of the Buse soil is dark gray extremely stony loam about 7 inches thick. The underlying material, to a depth of 22 inches, is light brownish gray, friable, calcareous clay loam. Below that, to a depth of 60 inches, it is light gray, calcareous clay loam. In places where erosion has removed part or all of the original surface layer, the present surface layer is lighter in color.

Included in mapping and making up about 20 percent of the unit are small areas of Arvilla, Parnell, Renshaw, Sioux, Svea, Tonka, and Vallers soils. Arvilla, Renshaw, and Sioux soils are on ridges in areas where there are small pockets of sand and gravel. The moderately well drained Svea soils are on foot slopes and in swales.

Parnell and Tonka soils are poorly drained and are in sloughs and depressions. Vallers soils are poorly drained and are around and between depressions and in low swales.

Permeability in the Barnes soil is moderate in the subsoil and moderately slow in the underlying material, and in the Buse soil it is moderately slow. In the Barnes soil, the organic matter content is moderate and fertility is medium or high. In the Buse soil, the organic matter content is moderate or low and fertility is low or medium. The available water capacity of the Barnes and Buse soils is high. Runoff is medium to rapid. The high content of lime in the Buse soil restricts the availability of plant nutrients.

In most areas, these soils are in native grass and are used for grazing. These soils have poor potential for crops, for use as tame pasture and hayland, for windbreaks and environmental plantings, and for the development of habitat for openland wildlife. The Barnes soil has good potential for use as rangeland and for the development of habitat for rangeland wildlife, and the Buse soil has fair potential for these uses. These soils have poor potential for building site development and sanitary facilities.

The soils in this unit are best suited to use as rangeland. The native vegetation is a mixture of short, mid, and tall grasses. Controlling erosion is the main concern of management. Maintaining an adequate vegetative cover and ground mulch helps to reduce runoff, thus preventing excessive soil loss and improving the moisture supply. Overgrazing the rangeland reduces the vegetative cover and causes deterioration of the plant community; the taller, more productive grasses are replaced by less productive short grasses and weeds. A planned grazing system that includes proper grazing use and deferred grazing helps to maintain or improve the range condition. Potential sites for stockwater dugouts are plentiful.

These soils are too stony or too steep for use as sites for windbreaks and environmental plantings. The Barnes soil is suited to wildlife habitat and beautification plantings that are hand-planted and given special care.

If these soils are used for building site development and for local roads and streets, the large surface stones and steep slopes are major limitations. Local roads should be constructed on raised and well compacted material to help prevent damage by frost action and by the shrinking and swelling of the soil. Mulching and seeding adapted grasses in borrow areas help to control roadside erosion and to prevent gully erosion. These soils generally are too steep and too stony for use as septic tank absorption fields and sewage lagoons.

Capability unit VIIs-1; the Barnes soil is in Silty range site, the Buse soil is in Thin Upland range site.

BbB—Barnes-Svea loams, 1 to 6 percent slopes. These are deep, well drained and moderately well drained, gently undulating soils on knolls and side slopes and in swales on uplands. In some areas, stones that are about 2 to 5 feet apart are on the upper part of knolls. The areas of this map unit are irregular in shape and range from 3 to 30 acres in size. The Barnes soil makes up 55 to 65 percent of the unit, and the Svea soil makes up 25 to 30 percent. The Barnes soil is on the top of knolls and on the middle and upper parts of side slopes. The Svea soil is on foot slopes and in swales and frequently is flooded for a very brief period. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Barnes soil is dark gray loam about 5 inches thick. The subsoil is dark grayish brown, friable loam about 8 inches thick. The underlying material, to a depth of 60 inches, is grayish brown and pale yellow, calcareous loam. In some cultivated areas where material from the subsoil has been mixed with the original surface layer by plowing, the present surface layer is lighter in color. In places, the subsoil has a stronger grade of structure than is typical.

Typically, the surface layer of the Svea soil is dark gray loam about 13 inches thick. The subsoil is friable loam about 15 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The underlying material, to a depth of 60 inches, is light brownish gray, calcareous loam; strata of sandy loam are in the lower part. In places, the subsoil is thicker and lime is at a greater depth than is typical. In some areas, the surface layer and subsoil have more silt and less sand than is typical.

Included in mapping and making up about 15 percent of the unit are small areas of the well drained Heimdal and Peever soils and areas of the poorly drained Tonka and Vallers soils. Heimdal and Peever soils are in positions on the landscape similar to those of the Barnes soil. Heimdal soils have less clay and Peever soils have more clay than the Barnes soil. Tonka soils are in shallow depressions. Vallers soils are near the edge of depressions.

The organic matter content in the Barnes soil is moderate, and in the Svea soil it is moderate or high. Fertility in the Barnes and Svea soils is medium or high. Permeability is moderate in the upper part of these soils and moderately slow in the lower part. The available water capacity is high. Runoff is medium. The shrink-swell potential is moderate. The Svea soil has a water table between depths of 4 and 6 feet in spring.

In most areas, these soils are used for farming. In a few areas, they are in native grass and are used for grazing or as hayland. These soils have good potential for crops; for use as tame pasture, hayland, or rangeland; for windbreaks and environmental plantings; and for the development of habitat for openland wildlife. They have fair potential for the development of habitat for rangeland wildlife. The Barnes soil has fair potential for

building site development and sanitary facilities, and the Svea soil has poor potential for these uses.

These soils are suited to corn, small grains, and grasses and legumes for pasture and hay. If these soils are used for crops, controlling erosion on the Barnes soil and maintaining fertility are the main management concerns. Minimum tillage and the use of grasses and legumes in the cropping system help to control erosion and to improve fertility and the organic matter content. In areas of the Svea soil, planting and harvesting commonly are delayed in wet periods.

Using these soils as tame pasture and hayland also is effective in controlling erosion. Maintaining an adequate vegetative cover helps to prevent soil loss. Stocking at the proper rate, rotating pasture, and deferring grazing help to keep pasture and soil in good condition.

These soils are well suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs grow well if the competing vegetation is controlled. Good site preparation, cultivation, and the use of herbicides help in controlling competing vegetation.

The Svea soil should not be used for building site development because it is subject to flooding. If the Barnes soil is used as a site for buildings, foundations and footings should be reinforced to prevent structural damage by the shrinking and swelling of the soil. Local roads should be constructed on raised and well compacted material to help prevent damage to the road by frost action. The base material needs to be strengthened because the soils have low strength. Because of the slow absorption of liquid waste in septic tank absorption fields, the absorption area needs to be enlarged. If sewage lagoons are constructed in areas of the Barnes soil, the surface needs to be shaped. The Svea soil has few limitations for sewage lagoons.

Capability unit IIe-2; the Barnes soil is in Silty range site, and the Svea soil is in Overflow range site.

BbC—Barnes-Svea loams, 3 to 9 percent slopes. These are deep, well drained and moderately well drained, gently sloping and moderately sloping soils on ridges and side slopes and in swales on uplands. A few cobblestones and stones are scattered on the surface on some of the higher parts of the landscape. The areas of this map unit are irregular in shape and range from 3 to 90 acres in size. They are 50 to 60 percent Barnes soil and 25 to 30 percent Svea soil. The Barnes soil is on knolls and on the middle and upper parts of side slopes. The Svea soil is on foot slopes and in swales and frequently is flooded for a very brief period. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Barnes soil is dark gray loam about 5 inches thick. The subsoil is dark grayish brown, friable loam about 8 inches thick. The underlying material, to a depth of 60 inches, is grayish brown and pale yellow, calcareous loam. In some cultivated areas where material from the subsoil has been mixed with the original surface layer by plowing, the present surface layer is lighter in color. In places, the subsoil has a stronger grade of structure than is typical.

Typically, the surface layer of the Svea soil is dark gray loam about 13 inches thick. The subsoil is friable loam about 15 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The underlying material, to a depth of 60 inches, is light brownish gray, calcareous loam; strata of sandy loam are in the lower part. In places, the subsoil is thicker and lime is at a greater depth than is typical. In some areas, the surface layer and subsoil have more silt and less sand than is typical.

Included in mapping and making up less than 20 percent of any one mapped area are small areas of the well drained Buse and Heimdal soils and areas of the poorly drained Tonka and Vallers soils. Also included are small areas of the somewhat excessively drained Renshaw soils. Buse soils are on knolls; they do not have a subsoil and have carbonates at a lesser depth than the Barnes soil. Tonka soils are in shallow depressions. Vallers soils are near the edge of depressions. Renshaw soils are in areas where there are pockets of sand and gravel.

The organic matter content in the Barnes soil is moderate, and in the Svea soil it is moderate or high. Fertility in the Barnes and Svea soils is medium or high. Permeability is moderate in the upper part of these soils and moderately slow in the lower part. The available water capacity is high. Runoff is medium. The shrink-swell potential is moderate. The Svea soil has a high water table between depths of 4 and 6 feet in spring.

In some areas, these soils are used for farming. In other areas, they are used for hay and as pasture, and in a few areas they are in native grass. These soils have fair potential for crops. They have good potential for use as tame pasture, hayland, or rangeland; for windbreaks and environmental plantings; and for the development of habitat for openland and rangeland wildlife. The Barnes soil has fair potential for building site development and sanitary facilities, and the Svea soil has poor potential for these uses.

These soils are suited to corn, small grains, and grasses and legumes for pasture and hay. If these soils are used for crops, controlling erosion and maintaining fertility are the main management concerns. Minimum tillage and the use of close-growing crops and grasses and legumes help to prevent excessive soil loss. Terraces and contour farming reduce erosion and help to control runoff. Returning crop residue and adding other organic material to the soil help to improve fertility and increase the rate of water intake. In areas of the Svea soil, planting and harvesting commonly are delayed in wet periods.

Using these soils as tame pasture or hayland also is effective in controlling erosion. Overgrazing pasture reduces the vegetative cover and increases runoff and erosion. Reseeding adapted grasses and applying fertilizer help to establish a good vegetative cover. Stocking at the proper rate, rotating pasture, controlling weeds, and deferring grazing help to keep pasture and soil in good condition.

These soils are well suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs survive and grow well if the competing vegetation is controlled. Good site preparation, cultivation, and the use of herbicides help in controlling competing vegetation. Planting trees on the contour helps to control erosion and to conserve moisture.

The Svea soil is poorly suited to building site development because it is subject to flooding. If the Barnes soil is used as a site for buildings, foundations and footings should be reinforced to prevent structural damage by the shrinking and swelling of the soil. Local roads and streets should be constructed on raised and well compacted material to help prevent damage by frost action. Base material needs to be strengthened because the soils have low strength. Because of the slow absorption of liquid waste in septic tank absorption fields, the absorption area needs to be enlarged. The Svea soil is poorly suited to use as septic tank absorption fields because it is subject to flooding and seasonal wetness. If sewage lagoons are to be constructed, the site for the sewage lagoon should be located in areas where the soils are less sloping. The Svea soil has few limitations for sewage lagoons.

Capability unit IIIe-1; Silty range site.

BbD—Barnes-Svea loams, 4 to 15 percent slopes. These are deep, well drained and moderately well drained, gently sloping to strongly sloping and rolling soils on knolls and side slopes and in swales on uplands. In places, a few cobblestones and stones are on the surface. In the higher positions on the landscape, slopes are short and convex. The areas of this map unit are irregular in shape and range from 2 to 90 acres in size. The Barnes soil makes up 40 to 50 percent of the unit, and the Svea soil makes up 25 to 35 percent. The Barnes soil is on the middle and upper parts of side slopes. The Svea soil is on foot slopes and in swales and frequently is flooded for a very brief period. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Barnes soil is dark gray loam about 5 inches thick. The subsoil is dark grayish brown, friable loam about 8 inches thick. The underlying material, to a depth of 60 inches, is grayish brown and pale yellow, calcareous loam. In some cultivated areas, the surface layer is lighter in color than is typical. In places, it is thicker than is typical.

Typically, the surface layer of the Svea soil is dark gray loam about 13 inches thick. The subsoil is friable loam about 15 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The underlying material, to a depth of 60 inches, is light brownish gray, calcareous loam; strata of sandy loam are in the lower part. In places, the surface layer and subsoil are thicker than is typical.

Included in mapping are small areas of Buse, Renshaw, Tonka, and Vallers soils. These soils make up less than 25 percent of any one mapped area. Buse soils are on the higher part of knolls and ridges; they do not have a subsoil and have carbonates at a lesser depth than the Barnes soil. Renshaw soils have sand and gravel between depths of 10 and 20 inches and are in areas where there are pockets of sand and gravel. Tonka soils are poorly drained and are in shallow depressions. Vallers soils are poorly drained and are in shallow drainageways and around depressions.

The organic matter content in the Barnes soil is moderate, and in the Svea soil it is moderate or high. Fertility in the Barnes and Svea soils is medium or high. Permeability is moderate in the upper part of these soils and moderately slow in the lower part. The available water capacity is high. Runoff is medium to rapid. The shrink-swell potential is moderate. The Svea soil has a high water table between depths of 4 and 6 feet in spring.

In most areas, these soils are used as tame pasture and hayland. In a few areas, they are used as rangeland. These soils have fair potential for crops and for the development of habitat for openland wildlife. They have good potential for use as tame pasture and hayland, for windbreaks and environmental plantings, and for the development of habitat for rangeland wildlife. The Barnes soil has fair potential for building site development and most sanitary facilities, and the Svea soil has poor potential.

The soils in this unit generally are better suited to small grains and grasses and legumes than to row crops. If these soils are cultivated, the main concerns of management are controlling erosion and maintaining or improving fertility. Minimum tillage and the use of close-growing crops and grasses and legumes help to prevent excessive soil loss. Terraces and contour farming reduce erosion and help to control runoff. Returning crop residue and adding other organic material to the soil help to improve fertility and increase the rate of water intake. In some areas of the Svea soil, planting and harvesting commonly are delayed in wet periods.

Using these soils as tame pasture or hayland also is effective in controlling erosion. Overstocking pasture reduces the vegetative cover and increases runoff and erosion. Stocking at the proper rate, rotating pasture, seeding adapted grasses, and deferring grazing help to keep pasture and soil in good condition. Potential sites for stockwater dugouts are along the shallow drainageways.

These soils are suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs grow well if the competing vegetation is controlled. Good site preparation, cultivation, and the use of herbicides help in controlling competing vegetation. Planting trees on the contour helps to control erosion and to conserve moisture.

If buildings are constructed on these soils, foundations and footings should be reinforced, and runoff should be diverted from the building site to help prevent structural damage by the shrinking and swelling of the soil. Local roads should be constructed on raised and well compacted material to help prevent damage by frost action. The base material needs to be strengthened because these soils have low strength. Mulching and seeding adapted grasses help to control roadside erosion and to prevent gully erosion in borrow areas. If these soils are used as septic tank absorption fields, the absorption area should be enlarged because of the restricted permeability of the soils. The Svea soil should not be used as a site for septic tank absorption fields because it is subject to flooding and seasonal wetness. The best sites for septic tank absorption fields are areas of the less sloping Barnes soil. Sewage lagoons also should be located where the soils are less sloping. The Svea soil has few limitations for sewage lagoons.

The Barnes soil is in capability unit IVe-1, and the Svea soil is in capability unit IIe-1; Silty range site.

Bc—Bearden silty clay loam. This is a deep, nearly level, somewhat poorly drained soil in swales and in flat, basinlike areas. The areas are irregular in shape and range from 6 to 300 acres in size.

Typically, the surface layer is dark gray, calcareous silty clay loam about 11 inches thick. The next layer is dark gray and light brownish gray, friable, calcareous silty clay loam about 7 inches thick. The underlying material, to a depth of 60 inches, is light yellowish brown and pale yellow, calcareous silty clay loam. In some cultivated areas, there are spots where the upper layers have been mixed by plowing. In some areas, layers of loamy and sandy soil material are within a depth of 40 inches.

Included in mapping are small areas of the poorly drained Dovray and Tonka soils. These soils make up less than 10 percent of any one mapped area. Dovray soils are in shallow drainageways, and Tonka soils are in shallow depressions.

Permeability is moderately slow or slow. The available water capacity is high. The organic matter content is moderate or high, and fertility is medium. Runoff is slow. The water table is between depths of 1.5 and 2.5 feet early in spring and in wet periods. This soil is mildly alkaline or moderately alkaline throughout.

In most areas, this soil is used for farming. It has good potential for crops; for use as tame pasture, hayland, or rangeland; for windbreaks and environmental plantings; and for the development of habitat for openland and rangeland wildlife. It has poor potential for building site development and sanitary facilities.

This soil is suited to corn, small grains, soybeans, and grasses and legumes for pasture and hay. If this soil is used for crops, the main concerns of management are maintaining fertility and controlling soil blowing and seasonal wetness. Because of the high content of lime in this soil, the availability of plant nutrients is restricted, and the soil is susceptible to soil blowing. Returning crop residue to the soil and adding other organic material and fertilizer to the soil help to improve fertility and increase the organic matter content. The use of stubble mulch, field windbreaks, and winter cover crops helps to control soil blowing. Planting and harvesting commonly are delayed in wet periods because of the high water table.

If this soil is used as tame pasture and hayland, the main concerns of management are related to wetness. Overstocking tame pasture when the soil is too wet causes surface compaction and poor tilth. Stocking at the proper rate, rotating pasture, deferring grazing, and reseeding adapted grasses can help to keep pasture and soil in good condition.

This soil is well suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs survive and grow well if the competing vegetation is controlled. Good site preparation, cultivation, and the use of herbicides help to control competing vegetation.

This soil is poorly suited to building site development because of the seasonal high water table. Sites that are more suitable for this use generally are available on the adjacent upland soils. Roads should be constructed on raised and well compacted material to help prevent damage to the road by frost action. The base material needs to be strengthened or replaced because this soil has low strength. This soil is poorly suited to use as septic tank absorption fields or sewage lagoons because it has a seasonal high water table. If sanitary facilities need to be constructed, they should be located on the adjacent upland soils.

Capability unit IIe-4; Silty range site.

Bd—Brookings silt loam. This is a deep, nearly level, moderately well drained soil on broad flats and in swales on uplands. In spring and summer, this soil is subject to common flooding of very brief duration. The areas are irregular in shape and range from 10 to 35 acres in size.

Typically, the surface layer is about 12 inches thick. It is very dark gray silt loam about 7 inches thick in the upper part and dark gray silt loam about 5 inches thick in the lower part. The subsoil is about 21 inches thick. The upper part is gray, friable silty clay loam; the middle part is grayish brown, friable silty clay loam; and the lower part is light yellowish brown, friable, calcareous clay loam. The underlying material, to a depth of 60 inches, is pale yellow, calcareous clay loam glacial till. In some places, the glacial till is at a lesser depth than is typical.

Included in mapping are small areas of the moderately well drained Lismore soils on slight rises and the poorly drained Vallers soil in shallow drainageways. These soils make up less than 10 percent of any one mapped area.

Permeability is moderate in the surface layer and subsoil and moderately slow in the underlying material. The available water capacity is high. The organic matter content and fertility are high. The shrink-swell potential is moderate. Runoff is slow. In most areas, the water table is between depths of 3 and 6 feet in spring.

In most areas, this soil is used for farming. It has good potential for crops; for use as tame pasture, hayland, or windbreaks and environmental plantings; and for the development of habitat for openland wildlife. It has fair potential for the development of habitat for rangeland wildlife. This soil has poor potential for building site development and most sanitary facilities.

This soil is suited to corn, small grains, soybeans, and grasses and legumes for pasture and hay. If this soil is used for crops, controlling the seasonal wetness and maintaining tilth and fertility are the main concerns of management. Returning crop residue and other organic material to the soil and timely tillage help to maintain fertility and tilth. Diverting runoff from adjacent soils helps to control wetness.

This soil can be seeded for use as tame pasture. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Stocking at the proper rate, rotating pasture, deferring grazing, and restricting use in wet periods help to keep pasture and soil in good condition.

This soil is well suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs survive and grow well if the competing vegetation is controlled. Good site preparation, cultivation, and the use of herbicides help to control competing vegetation.

This soil should not be used for building site development because of the hazard of flooding and the perched water table. Buildings should be constructed on the adjacent upland soils. Roads should be constructed on raised and well compacted material, and drainage should be provided to help prevent road damage resulting from frost action and the low strength of this soil. This soil generally is not suited to use as a site for septic tank absorption fields and sanitary landfills because of the hazards of flooding and seasonal wetness. This soil has few limitations for sewage lagoons.

Capability unit I-3; Overflow range site.

BeF—Buse-Forman loams, 20 to 40 percent slopes. These are deep, well drained, moderately steep and steep soils on upland ridges and side slopes. In many areas, these soils are on the side slopes of long drainageways that dissect the uplands. In some areas, a few stones are scattered on the surface. The areas of this map unit generally are long and narrow in shape and range from 5 to 80 acres in size. They are 55 to 65 percent Buse soil and 25 to 35 percent Forman soil. The Buse soil is on ridges and on the upper part of side slopes of drainageways. The Forman soil is in the middle and lower landscape positions and has slopes that range from 20 to 25 percent. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Buse soil is dark gray loam about 7 inches thick. The underlying material, to a depth of about 22 inches, is light brownish gray, friable, calcareous clay loam; and below that, to a depth of 60 inches, it is light gray, calcareous clay loam. In places, the surface layer is thinner than is typical or has been removed through erosion.

Typically, the surface layer of the Forman soil is dark gray loam about 6 inches thick. The subsoil is about 17 inches thick. It is brown, friable clay loam in the upper part and grayish brown, calcareous clay loam in the lower part. The underlying material, to a depth of 60 inches, is light brownish gray, calcareous clay loam.

Included in mapping are small areas of Aastad, LaDelle, Renshaw, and Sioux soils. These soils make up less than 20 percent of any one mapped area. Aastad soils are on foot slopes and in swales and have a thicker surface layer than Buse and Forman soils. LaDelle soils are on bottom lands along drainageways. Renshaw and Sioux soils are on ridges that are mantled with sand and gravel.

Permeability is moderately slow in the Buse soil. In the Forman soil, it is moderate in the upper part and moderately slow in the underlying material. In the Buse soil, fertility is low or medium, and the organic matter content is moderate or low. In the Forman soil, fertility is medium or high, and the organic matter content is moderate or high. The available water capacity of the Buse and Forman soils is high. The shrink-swell potential is moderate. Runoff is rapid.

In most areas, these soils are in native grass and are used for grazing. The Buse soil has fair potential for use as rangeland, and the Forman soil has good potential. These soils have poor potential for crops, for use as tame pasture and hayland, for windbreaks and environmental plantings, and for the development of habitat for openland wildlife. The Buse soil has fair potential for the development of habitat for rangeland wildlife, and the Forman soil has good potential. These soils have poor potential for building site development and sanitary facilities.

These soils are best suited to use as rangeland. The natural plant cover is a mixture of tall, mid, and short grasses. Maintaining an adequate vegetative cover helps to reduce runoff, thus preventing excessive soil loss and improving the moisture-supplying capacity of the soils. Overgrazing the rangeland reduces the vegetative cover and causes deterioration of the plant community. The taller, more productive grasses are replaced by less pro-

ductive short grasses and undesirable plants. A planned grazing system that includes proper grazing use and deferred grazing helps to maintain or improve the range condition and helps to control erosion. Potential sites for stockwater dugouts commonly are available in the wider draws along drainageways.

These soils generally are not suitable for crops or for use as tame pasture and hayland because of the steep slopes.

These soils are poorly suited to use as sites for windbreaks and environmental plantings. Selected trees and shrubs for wildlife habitat and beautification can be planted on the lower part of slopes.

These soils have severe limitations for building site development and sanitary facilities. The shrinking and swelling of the soils and frost action can cause damage to local roads unless roads are graded and the base material is well compacted. Mulching and seeding adapted grasses in the borrow areas help to control roadside erosion.

Capability unit VIIe-1; the Buse soil is in Thin Upland range site and the Forman soil is in Silty range site.

BfD—Buse-Forman-Aastad loams, 4 to 15 percent slopes. These are deep, well drained and moderately well drained, gently sloping to strongly sloping and rolling soils. They are on ridges and side slopes and in swales on uplands. Some areas are dissected by shallow drainageways. In some areas, a few stones are scattered on the ridgetops. In the higher positions on the landscape, slopes are short and convex. The areas of this map unit range from 5 to more than 100 acres in size. They are 40 to 50 percent Buse soil, 25 to 35 percent Forman soil, and 25 percent Aastad soil. The Buse soil is on the higher part of knolls and ridges. The Forman soil is on the middle and upper parts of side slopes. The Aastad soil is on foot slopes and in swales where the slopes commonly are less than 6 percent. It is frequently flooded for a brief period. These soils are so intermingled or the areas of each soil are so small in size that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Buse soil is dark gray loam about 7 inches thick. The underlying material, to a depth of about 22 inches, is light brownish gray, friable, calcareous clay loam. Below that, to a depth of 60 inches, it is light gray, calcareous clay loam. In cultivated areas where part or all of the original surface layer has been removed through erosion and part has been mixed with the underlying material by plowing, the present surface layer is light colored.

Typically, the surface layer of the Forman is dark gray loam about 6 inches thick. The subsoil is about 17 inches thick. It is brown, friable clay loam in the upper part and grayish brown, calcareous clay loam in the lower part. The underlying material, to a depth of 60 inches, is light brownish gray, calcareous clay loam. In places where the surface layer has been mixed with material from the subsoil by plowing, it is light colored.

Typically, the surface layer of the Aastad soil is about 17 inches thick. It is dark gray loam about 6 inches thick in the upper part and dark gray clay loam about 11 inches thick in the lower part. The subsoil is grayish brown, firm clay loam about 12 inches thick. The underlying material, to a depth of 60 inches, is light yellowish brown, calcareous loam. In places, the surface layer is thicker and the subsoil thinner than is typical.

Included in mapping are small areas of the poorly drained Tonka and Vallers soils. These soils make up less than 5 percent of any one mapped area. Also included are small areas of the well drained Hattie and Peever soils. Tonka soils are in shallow depressions. Vallers soils are around the depressions. Hattie and Peever soils have more clay and are on knolls and side slopes.

In the Forman soil, permeability is moderate in the upper part and moderately slow in the underlying material; in the Buse and Aastad soils, permeability is moderately slow. Fertility in the Buse soil is low or medium, and in the Forman and Aastad soils it is medium or high. The organic matter content in the Buse soil is moderate or low, and in the Forman and Aastad soils it is moderate or high. The available water capacity of the Buse, Forman, and Aastad soils is high. The shrink-swell potential is moderate in the subsoil or underlying material of these soils. Runoff is medium. In the Aastad soil, the water table is between depths of 3 and 6 feet for short periods in spring.

In most areas, these soils are used for farming (fig. 5). In a few areas, they are in native grass and are used for grazing or hay. These soils have fair potential for crops, for use as pasture and hayland, for the development of habitat for openland wildlife, and for windbreaks and environmental plantings. The Buse and Aastad soils have fair potential for use as rangeland and for the development of habitat for rangeland wildlife, and the Forman soil has good potential for these uses. All three soils have fair potential for building site development and poor potential for most sanitary facilities.

The soils in this unit are better suited to close-growing crops than to row crops. If these soils are used for crops, controlling erosion and maintaining fertility are the main concerns of management. The use of minimum tillage, close-growing crops, and grassed waterways helps to prevent excessive soil loss. Returning crop residue and adding other organic material to the soil help to improve fertility and increase the rate of water intake. The high content of lime in the Buse soil restricts the availability of plant nutrients. In areas of the Aastad soil, planting and harvesting commonly are delayed in wet periods.

Using these soils as tame pasture, hayland, or rangeland also is effective in controlling erosion. Overgrazing

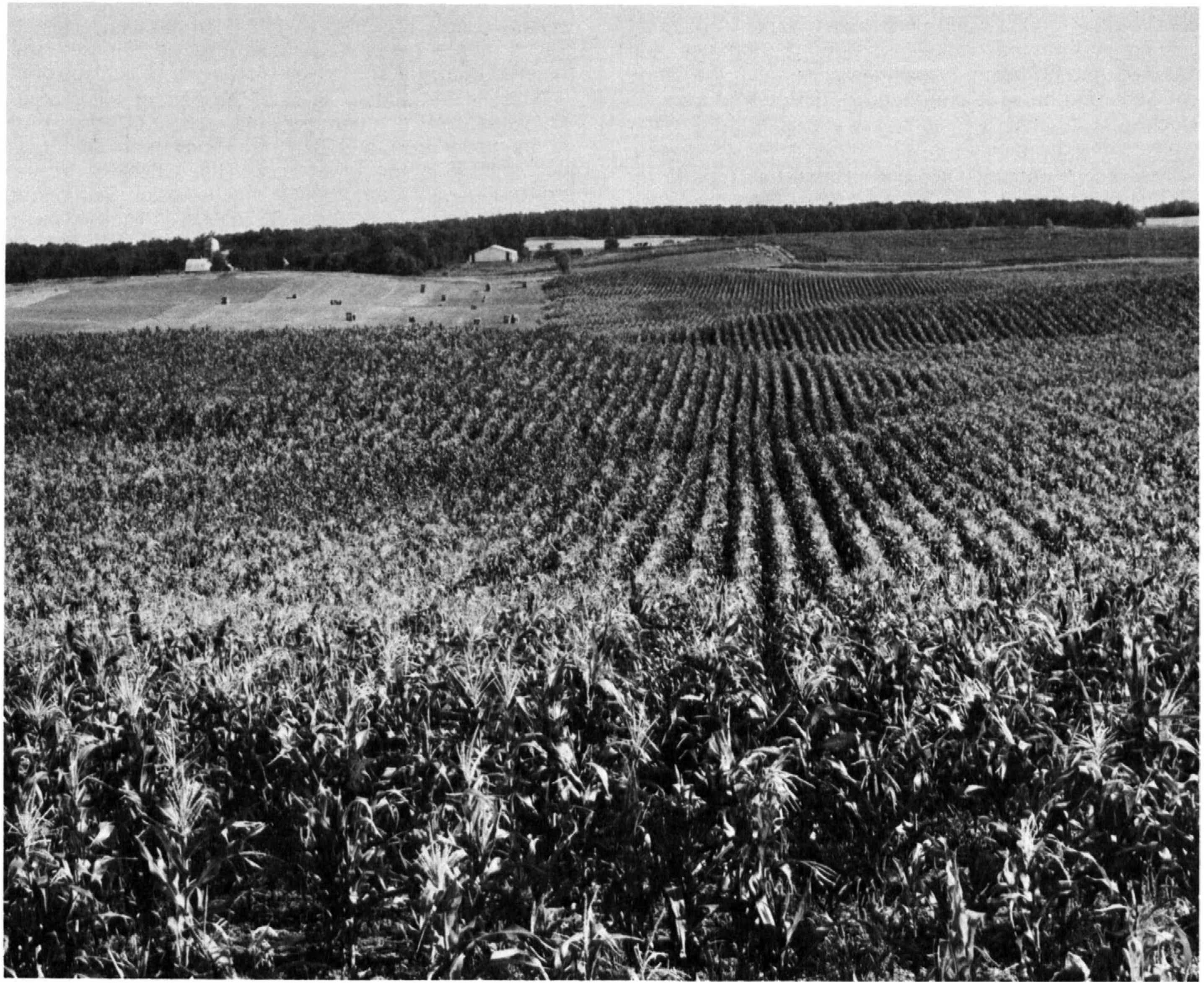


Figure 5.—Buse-Forman-Aastad loams, 4 to 15 percent slopes, are used mainly for farming.

tame pasture and rangeland reduces the vegetative cover and increases runoff and erosion. On tame pasture, reseeding adapted grasses and applying fertilizer help to establish a good vegetative cover. Stocking at the proper rate, rotating grazing, controlling weeds, and deferring grazing help to keep pasture in good condition. A planned grazing system that includes proper grazing use and deferred grazing helps to maintain or improve the condition of rangeland.

The Buse soil in this unit is not well suited to use as sites for windbreaks and environmental plantings; the Forman and Aastad soils are well suited to this use. All climatically adapted trees and shrubs on the Forman and Aastad soils survive and grow well if the competing vegetation is controlled. Good site preparation, the use of herbicides, and cultivation help in controlling competing vegetation. Planting trees on the contour helps to control erosion and to conserve moisture.

If buildings are constructed on these soils, foundations and footings should be reinforced and runoff should be diverted from the building site to help prevent structural damage by the shrinking and swelling of the soil. Local roads should be constructed on raised and well compacted material to help prevent damage to the road by frost action and shrinking and swelling. Mulching and seeding adapted grasses help to control roadside ero-

sion and to prevent gully erosion in borrow areas. Culverts and drainage ditches can provide drainage in areas of the Aastad soil.

If these soils are used as septic tank absorption fields, the absorption area needs to be enlarged because liquid wastes are absorbed slowly. The Aastad soil is poorly suited to use as septic tank absorption fields because it is subject to flooding and seasonal wetness. The best sites for septic tank absorption fields are in the most gently sloping areas of the Forman soil. The Buse and Forman soils generally are too steep for use as sites for sewage lagoons. The Aastad soil has few limitations for sewage lagoons.

The Buse soil is in capability unit VIe-3, Thin Upland range site; the Forman soil is in capability unit IVe-1, Silty range site; the Aastad soil is in capability unit IIe-1, Silty range site.

Da—Divide loam. This is a nearly level, moderately well drained or somewhat poorly drained soil in swales and on flats on glacial outwash plains. There are sluggish drainageways in some areas. This soil is moderately deep over stratified sand and gravel. The areas are irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer is about 19 inches thick. It is very dark gray, calcareous loam about 7 inches thick in the upper part and gray, very friable, calcareous loam about 12 inches thick in the lower part. The underlying material, to a depth of 23 inches, is light brownish gray, calcareous loam, and to a depth of 30 inches it is grayish brown, calcareous loamy sand. Light brownish gray, calcareous sand and gravel are at a depth of 30 inches. In places, this soil has more silt than is typical, does not have coarse sand and gravel, and has glacial till at a depth of 40 to 50 inches. In some areas, sand and gravel are within a depth of 20 inches.

Included in mapping are small areas of Marysland, Rauville, and Renshaw soils. These soils make up less than 15 percent of any one mapped area. The poorly drained Marysland soils and the very poorly drained Rauville soils are in low, wet areas. The somewhat excessively drained Renshaw soils are on slight rises.

Permeability is moderate in the upper part of the soil and rapid in the underlying sand and gravel. The available water capacity is low or moderate. The organic matter content is moderate, and fertility is medium. The shrink-swell potential is low. Runoff is slow. The water table is between depths of 2.5 and 5 feet in spring and during periods of heavy rainfall.

In most areas, this soil is used for farming. In a few areas, it is in native grass and is used for grazing and hay. This soil has fair potential for crops. It has good potential for use as tame pasture, hayland, or rangeland; for windbreaks and environmental plantings; and for the development of habitat for openland and rangeland wildlife. This soil has fair potential for building site development and poor potential for sanitary facilities.

This soil is suited to small grains, sunflowers, and grasses and legumes for tame pasture and hay. If this soil is cultivated and left unprotected, soil blowing is a hazard. The availability of plant nutrients is restricted by the high content of lime in the root zone. During extended dry periods, drought can damage late-maturing crops, and in wet years, wetness from the water table delays farming operations. Returning crop residue or adding other organic material to the soil helps to improve fertility. The use of winter cover crops and windbreaks helps to control soil blowing. The Marysland and Rauville soils, which are included with this Divide soil in mapping, can delay cultivation in most years because of their wetness. Where feasible, the wetness problem can be overcome by improving surface drainage.

If this soil is used as tame pasture or hayland, the main limitations are the seasonal wetness, the moderately deep root zone, and the low to moderate available water capacity of this soil. Stocking at the proper rate, rotating pasture, controlling weeds, deferring grazing, and restricting use in wet periods help to keep pasture in good condition.

This soil is well suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs survive and grow well if the competing vegetation is controlled. Good site preparation, cultivation, and the use of herbicides help in controlling competing vegetation.

If buildings are constructed on this soil, the footings and foundations should be reinforced to help overcome the low strength of the soil. Buildings should be constructed on fill material to help overcome the adverse water table conditions. Roads can be graded and the base material strengthened to prevent damage by frost action and to help overcome the low strength of the soil. This soil is poorly suited to use as a site for sanitary facilities because of the seasonal high water table and the hazard of seepage in the underlying sand and gravel. If needed, sanitary facilities should be installed on the adjacent upland soils.

Capability unit IIIs-4; Silty range site.

Db—Dovray silty clay. This is a deep, nearly level, poorly drained soil on bottom lands and in slightly concave depressions. In spring and summer, this soil is commonly flooded for brief periods. The areas are irregular in shape and range from 8 to more than 300 acres in size.

Typically, the surface layer is about 21 inches thick. It is very dark gray silty clay about 9 inches thick in the upper part and dark gray silty clay about 12 inches thick in the lower part. The subsoil is dark gray and olive gray, very firm silty clay about 20 inches thick. The underlying material, to a depth of 60 inches, is gray, calcareous clay loam. In places, lime is at a depth of 10 inches. In some

areas, the surface layer is clay loam. Silty clay loam and clay loam soil materials are within a depth of 40 inches in some places. In places, the subsoil has a higher content of sodium than is typical.

Included in mapping are small areas of Bearden and LaDelle soils. These soils make up less than 15 percent of any one mapped area. The silty Bearden soils are on slight rises. LaDelle soils have better drainage, have less clay, and are in higher positions on the landscape than this Dovray soil.

Permeability is very slow. The available water capacity is moderate or high. Fertility is medium or high, and the content of organic matter is high. The shrink-swell potential is high. Runoff is very slow, and water ponds on the surface in undrained areas. This soil is difficult to till, and tilth deteriorates if this soil is farmed when wet. The seasonal water table is at the surface or within a depth of 3 feet.

In most areas, this soil is used for farming. In a few areas, it is in native grass and is used for grazing and hay. This soil has good potential for crops; for use as tame pasture, hayland, or rangeland; for windbreaks and environmental plantings; and for the development of habitat for openland and rangeland wildlife. This soil has poor potential for building site development and most sanitary facilities.

If it is adequately drained, this soil is suited to corn, soybeans, sunflowers, small grains, and grasses and legumes for pasture and hay. If this soil is used for crops, controlling wetness and maintaining tilth are the main concerns of management. Returning crop residue and other organic material to the soil and timely tillage help to maintain fertility and tilth. Drainage helps control wetness.

This soil is well suited to use as tame pasture and hayland. However, overgrazing pasture or grazing when the soil is too wet causes surface compaction and poor tilth. Stocking at the proper rate, rotating pasture, deferring grazing, and restricting use of the pasture in wet periods help to keep pasture in good condition.

This soil is suited to use as sites for windbreaks and environmental plantings if the excess water is removed. All climatically adapted trees and shrubs grow well because the moisture supply is good. The suitability of this soil for trees and shrubs can be improved by providing drainage in the wetter areas. Competing vegetation can be controlled through good site preparation, cultivation, and the use of herbicides. Wetness is a limitation to planting trees.

This soil is poorly suited to building site development because it is subject to flooding and has a high water table. Buildings should be constructed on the adjacent upland soils. Local roads should be constructed on raised and well compacted material, and drainage should be provided to help prevent damage to the road by frost action and by the shrinking and swelling of the soil. Suitable base material can be excavated from the adjacent upland soils. This soil has few limitations to use as a site for sewage lagoons.

Capability unit IIw-1; Clayey range site.

EaA—Egeland sandy loam, 0 to 2 percent slopes. This is a deep, nearly level, well drained soil on smooth upland flats. The areas are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is dark gray sandy loam about 8 inches thick. The subsoil is about 27 inches thick. The upper part of the subsoil is dark brown, very friable sandy loam; the middle part is yellowish brown, very friable sandy loam; and the lower part is light yellowish brown, very friable loamy sand. The underlying material, to a depth of 60 inches, is pale brown, calcareous loamy fine sand. In places where this soil has been subject to soil blowing, the surface layer is thinner than is typical and is lighter in color.

Included in mapping and making up less than 10 percent of any one mapped area are small, low areas of the moderately well drained Swenoda soils. Swenoda soils have clay loam or loam glacial till within a depth of 40 inches.

Permeability is moderately rapid. The available water capacity is low or moderate. The content of organic matter is moderate, and fertility is medium. Runoff is slow.

In most areas, this soil is used for farming. In a few areas, it is in native grass and is used for grazing or hay. This soil has fair potential for crops and for the development of habitat for openland wildlife. It has good potential for use as tame pasture, hayland, or rangeland and for windbreaks and environmental plantings. This soil has good potential for building site development and poor potential for most sanitary facilities.

This soil is suited to corn, small grains, soybeans, and grasses and legumes for hay and pasture. If this soil is used for crops, conserving moisture and controlling soil blowing are the main management concerns. Minimum tillage, the use of field windbreaks, and stripcropping help to conserve moisture and to control soil blowing. Returning crop residue and adding other organic material to the soil help to improve fertility and to increase the organic matter content.

Using this soil as tame pasture, hayland, or rangeland also is effective in controlling soil blowing. Maintaining an adequate vegetative cover helps to prevent soil loss. Stocking at the proper rate, rotating grazing, deferring grazing, controlling weeds, and applying fertilizer help to keep pasture in good condition.

This soil is well suited to use as sites for windbreaks and environmental plantings. Trees and shrubs survive and grow well if the competing vegetation is controlled. Good site preparation, cultivation, and the use of herbicides help in controlling competing vegetation. Keeping a mulch of crop residue on the surface helps to control soil blowing during site preparation.

This soil is well suited to building site development; however, the caving or sloughing of walls in shallow excavations is a hazard. This soil has few limitations to use as sites for local roads and streets; however, borrow areas are subject to soil blowing and should be reseeded to adapted grasses. Septic tank absorption fields function well; however, all sanitary facilities are a potential source of pollution to ground water.

Capability unit IIIs-1; Sandy range site.

EaB—Egeland sandy loam, 2 to 6 percent slopes. This is a deep, well drained, gently undulating soil on convex ridgetops, knolls, and short side slopes. The areas are irregular in shape and range from 8 to 70 acres in size.

Typically, the surface layer is dark gray sandy loam about 8 inches thick. The subsoil is about 27 inches thick. The upper part of the subsoil is dark brown, very friable sandy loam; the middle part is yellowish brown, very friable sandy loam; and the lower part is light yellowish brown, very friable loamy sand. The underlying material, to a depth of 60 inches, is pale brown, calcareous loamy fine sand. In places, the surface layer is thinner and lighter in color than is typical. In areas where this soil is on the lower part of side slopes, the surface layer is thicker than is typical. In places, slopes are as much as 9 percent.

Included in mapping are small areas of Heimdal, Maddock, and Swenoda soils. These soils make up less than 15 percent of any one mapped area. Heimdal soils have more silt and clay than this Egeland soil. Maddock soils are on ridges and knolls and have less clay and more sand than this soil. Swenoda soils are moderately well drained and have loam or clay loam glacial till within a depth of 40 inches.

Permeability is moderately rapid. The available water capacity is low or moderate. The content of organic matter is moderate, and fertility is medium. Runoff is medium.

In most areas, this soil is used for farming. In a few areas, this soil is in native grass and is used for grazing or hay. This soil has fair potential for crops and for the development of habitat for openland wildlife. It has good potential for use as tame pasture, hayland, or rangeland; for windbreaks and environmental plantings; and for the development of habitat for rangeland wildlife. It has good potential for building site development and poor potential for most sanitary facilities.

This soil is suited to corn, small grains, soybeans, and grasses and legumes for pasture and hay. If this soil is used for cultivated crops, conserving moisture and controlling soil blowing and water erosion are the main management concerns. The use of minimum tillage, field windbreaks, winter cover crops, and stripcropping help to conserve moisture and to control soil blowing and water erosion. Returning crop residue or adding other organic material to the soil helps to improve fertility and to increase the organic matter content.

Using this soil as tame pasture, hayland, or rangeland also is effective in controlling soil blowing and water erosion. Maintaining an adequate vegetative cover and ground mulch helps to reduce runoff, thus preventing excessive soil loss and improving the moisture-supplying capacity of the soil. Stocking at the proper rate, rotating grazing, deferring grazing, controlling weeds, and applying fertilizer help to keep pasture in good condition.

This soil is well suited to use as sites for windbreaks and environmental plantings. Trees and shrubs survive and grow well if the competing vegetation is controlled. Good site preparation, cultivation, and the use of herbicides help in controlling the competing vegetation. Keeping a mulch of crop residue on the surface helps to control soil blowing during site preparation.

This soil is well suited to building site development; however, the caving or sloughing of walls in shallow excavations is a hazard. This soil has few limitations to use as sites for local roads and streets; however, borrow areas are subject to soil blowing and should be seeded to adapted grasses. Septic tank absorption fields function well; however, all sanitary facilities are a potential source of pollution to ground water.

Capability unit IIIe-7; Sandy range site.

Ec—Estelline silty clay loam. This is a nearly level, well drained soil on terraces and glacial outwash flats. This soil is moderately deep over sand and gravel. The areas are irregular in shape and range from 10 to 150 acres in size.

Typically, the surface layer is dark gray silty clay loam about 8 inches thick. The subsoil is about 16 inches thick. The upper part of the subsoil is very dark gray, friable silty clay loam, and the lower part is brown silty clay loam. The underlying material, to a depth of 60 inches, is brown sand and gravel. In places, glacial till is at depth between 40 and 60 inches. In some areas, the subsoil has more sand and less silt than is typical.

Included in mapping and making up less than 10 percent of any one mapped area are small areas of Renshaw soils. Renshaw soils are on slight rises and have sand and gravel within a depth of 20 inches.

Permeability is moderate in the subsoil and rapid in the underlying sand and gravel. The available water capacity is moderate or low. Fertility is medium or high, and the organic matter content is moderate. The shrink-swell potential is moderate above the gravel. Runoff is slow.

In most areas, this soil is used for farming. It has good potential for cultivated crops, for rangeland, for the development of habitat for rangeland wildlife, and for use as tame pasture and hayland. This soil has fair potential for the development of habitat for openland wildlife and for windbreaks and environmental plantings. It has fair potential for building site development and poor potential for most sanitary facilities.

This soil is suited to corn, small grains, soybeans, and grasses and legumes for hay and pasture. If this soil is used for crops, conserving moisture and maintaining fertility are the main management concerns. Minimum tillage, the use of field windbreaks, and returning crop residue to the soil help to conserve moisture. Using grasses or legumes in the cropping system helps to improve fertility and maintain tilth.

This soil is suited to use as tame pasture or hayland. Overstocking tame pasture causes deterioration of the plant community; the more desirable grasses lose vigor and are replaced by less productive grasses and other plants. Stocking at the proper rate, rotating grazing, deferring grazing, controlling weeds, and applying fertilizer help to keep pasture in good condition.

This soil is not well suited to use as sites for windbreaks and environmental plantings because sand and gravel are at a moderate depth. Properly selected trees and shrubs can be planted on this soil, but their rate of survival and growth is not good. Competing vegetation can be controlled through good site preparation, cultivation, and the use of herbicides.

If buildings are constructed on this soil, foundations and footings should be reinforced to help prevent damage by shrinking and swelling in the upper part of this soil. The caving or sloughing of walls in shallow excavations is a hazard. This soil does not have the strength to support vehicular traffic on local roads and streets, but the base material can be strengthened to overcome this limitation. Septic tank absorption fields function well; however, all sanitary facilities are a potential source of pollution to ground water.

Capability unit IIs-3; Silty range site.

Fa—Flom clay loam. This is a deep, poorly drained, nearly level soil on low flats, in swales, and along shallow drainageways. This soil is subject to frequent flooding of brief duration. The areas are irregular in shape and range from 2 to 35 acres in size.

Typically, the surface layer is about 17 inches thick. It is very dark gray clay loam about 9 inches thick in the upper part and dark gray clay loam about 8 inches thick in the lower part. The subsoil is grayish brown, friable clay loam about 8 inches thick. The underlying material, to a depth of 60 inches, is olive gray and light olive gray, calcareous clay loam. In places, carbonates are at a lesser depth and salts are in the lower part of the surface layer.

Included in mapping are small areas of the moderately well drained Aastad soils and the poorly drained Tonka and Vallers soils. These soils make up less than 10 percent of any one mapped area. Aastad soils are on slight rises. Tonka soils have more clay than this Flom soil and are in shallow depressions. Vallers soils have carbonates throughout. They are in lower areas and around depressions.

Permeability is moderately slow. The available water capacity is high. Fertility is medium to high, and the organic matter content is moderate to high. The shrink-swell potential is moderate. Runoff is slow. The seasonal water table is at a depth between 1 and 3 feet.

In some areas, this soil is used for farming. In other areas, it is in native grass and is used for grazing or hay. This soil has good potential for crops; for use as tame pasture, hayland, or rangeland; for windbreaks and environmental plantings; and for the development of habitat for openland wildlife. This soil has fair potential for the development of habitat for rangeland wildlife. This soil has poor potential for building site development and sanitary facilities.

If this soil is adequately drained, it is suited to corn, soybeans, small grains, and grasses and legumes for pasture and hay. If this soil is used for crops, controlling wetness and maintaining fertility and tilth are the main management concerns. Providing drainage and controlling runoff from adjacent soils help to control wetness. Crop residue management, the use of green manure crops, and timely tillage help to maintain tilth and fertility.

This soil is well suited to use as tame pasture and hayland. It is suited to all climatically adapted pasture plants. Stocking at the proper rate, rotating pasture, deferring grazing, controlling weeds, and restricting use of the pasture in wet periods help to keep pasture in good condition.

This soil is well suited to use as sites for windbreaks and environmental plantings if the excess water is removed. All climatically adapted trees and shrubs grow well because the moisture supply is good. The suitability of this soil for trees and shrubs can be improved by providing drainage in the wetter areas. Competing vegetation can be controlled through cultivation and the use of herbicides. Wetness is a limitation to planting trees.

This soil is poorly suited to building site development because it is subject to flooding and has a high water table. Buildings should be constructed on the adjacent, better drained soils. Local roads should be constructed on raised and well compacted material to help prevent damage to the road by frost action and by the shrinking and swelling of the soil. Culverts and drainage ditches can provide drainage. This soil is poorly suited to use as sites for sanitary facilities because the pollution of ground water and flooding are hazards.

Capability unit IIw-3; Subirrigated range site.

FbA—Fordville loam, 0 to 2 percent slopes. This is a nearly level, well drained soil on stream terraces and glacial outwash plains. This soil is moderately deep over sand and gravel. The areas are irregular in shape and range from 4 to 120 acres in size.

Typically, the surface layer is dark gray loam about 7 inches thick. The subsoil is friable loam about 17 inches thick. The upper part of the subsoil is dark gray, the middle part is grayish brown, and the lower part is light

olive brown. The underlying material, to a depth of 60 inches, is grayish brown and light brownish gray sand and gravel. In places, the surface layer and subsoil are clay loam. In some areas, sand and gravel are below a depth of 40 inches.

Included in mapping are small areas of the moderately well drained Divide soils in narrow swales and the somewhat excessively drained Renshaw soils on slight rises. These soils make up less than 10 percent of any one mapped area. Renshaw soils have sand and gravel at a depth between 10 and 20 inches.

Permeability is moderate in the subsoil and rapid in the underlying sand and gravel. The available water capacity is low or moderate. Fertility is medium, and the content of organic matter is moderate. Runoff is slow.

In most areas, this soil is used for farming. This soil has good potential for cultivated crops; for use as tame pasture, hayland, or rangeland; and for the development of habitat for openland and rangeland wildlife. This soil has fair potential for windbreaks and environmental plantings. It has good potential for building site development and poor potential for most sanitary facilities.

This soil is suited to corn, small grains, soybeans, and grasses and legumes for pasture and hay. If this soil is used for crops, conserving moisture is the main concern of management. Minimum tillage and returning crop residue to the soil help to conserve moisture. Grasses and legumes in the cropping system help to maintain fertility.

This soil is suited to use as tame pasture and hayland. Overgrazing tame pasture causes deterioration of the plant community; the more desirable grasses lose vigor and are replaced by less productive grasses and other plants. Stocking at the proper rate, rotating grazing, controlling weeds, and deferring grazing help to keep pasture in good condition. Seeding adapted grasses and applying fertilizer help to increase production.

Because this soil is somewhat droughty, the growth of trees and shrubs in windbreaks and environmental plantings is restricted. Drought-tolerant trees and shrubs can be planted on this soil, but, in most years, their rate of survival and growth is not good. Competing vegetation can be controlled through good site preparation, cultivation, and the use of herbicides.

This soil is well suited to building site development; however, the caving or sloughing of walls in shallow excavations is a hazard. If this soil is used for local roads and streets, the base material can be strengthened to help overcome the low strength of this soil. Septic tank absorption fields function well; however, all sanitary facilities on this soil are a potential source of pollution to ground water.

Capability unit IIs-3; Silty range site.

FcB—Fordville-Renshaw loams, 2 to 6 percent slopes. These are well drained and somewhat excessively drained, gently undulating and gently sloping soils on knolls and side slopes and in shallow swales. They are moderately deep and shallow over sand and gravel. The areas of this map unit are irregular in shape and range from 5 to 45 acres in size. They are 60 to 70 percent Fordville soil and 25 to 35 percent Renshaw soil. The Fordville soil is on the middle and lower parts of plane side slopes and in shallow swales. The Renshaw soil is on convex knolls and on the upper part of side slopes. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Fordville soil is dark gray loam about 7 inches thick. The subsoil is friable loam about 17 inches thick. The upper part of the subsoil is dark gray, the middle part is grayish brown, and the lower part is light olive brown. The underlying material, to a depth of 60 inches, is grayish brown and light brownish gray sand and gravel. In places, sand and gravel are at a depth of more than 40 inches. In areas where material from the subsoil has been mixed into the original surface layer by plowing, the present surface layer is lighter colored than is typical.

Typically, the surface layer of the Renshaw soil is dark gray loam about 6 inches thick. The subsoil is very friable loam about 12 inches thick. The upper part of the subsoil is dark gray, and the lower part is grayish brown and brown. The underlying material, to a depth of 60 inches, is grayish brown and brown sand and gravel.

Included in mapping are small areas of Divide and Sioux soils. These soils make up less than 10 percent of any one mapped area. Divide soils are wetter than the Fordville and Renshaw soils and are in shallow drainageways. Sioux soils are on gravelly knolls and generally have sand and gravel at a lesser depth.

Permeability is moderate in the upper part of the Fordville soil and moderately rapid in the upper part of the Renshaw soil. It is rapid in the underlying sand and gravel of both soils. The available water capacity in the Fordville soil is low or moderate, and in the Renshaw soil it is low. Fertility in the Fordville soil is medium, and in the Renshaw soil it is low or medium. The organic matter content is moderate in both soils. Runoff is medium.

In most areas, these soils are used for farming. In a few areas, they are in native grass and are used for grazing or hay. These soils have fair potential for cultivated crops and for the development of habitat for openland wildlife. The Fordville soil has good potential for use as tame pasture, hayland, or rangeland and for the development of habitat for rangeland wildlife. It has fair potential for windbreaks and environmental plantings. The Renshaw soil has poor potential for use as rangeland, for the development of habitat for rangeland wildlife, and for windbreaks and environmental plantings. It has fair potential for use as tame pasture and hayland. These soils have good potential for building site development and poor potential for most sanitary facilities.

These soils are best suited to early maturing crops such as small grains and alfalfa. If these soils are used for crops, conserving moisture and controlling erosion

are the main concerns of management. The use of minimum tillage, winter cover crops, and grasses and legumes in the cropping system helps to control erosion and conserve moisture.

Using these soils as tame pasture, hayland, or rangeland also is effective in controlling erosion. However, overgrazing decreases the vegetative cover and increases runoff and erosion. Stocking at the proper rate, rotating grazing, controlling weeds, and deferring grazing help to keep pasture in good condition. Seeding adapted grasses and applying fertilizer help to increase production. A planned grazing system that includes proper grazing use and deferred grazing helps to maintain or improve the condition of rangeland.

These soils are too droughty for the optimum growth of trees and shrubs in windbreaks and environmental plantings. Drought-tolerant trees and shrubs can be planted on this soil, but their rate of survival and growth are not good. These soils are suited to wildlife and beautification plantings if optimum growth is not a critical factor. Preparing the site properly and controlling the competing vegetation are necessary to provide adequate moisture.

These soils are well suited to building site development; however, the caving or sloughing of walls in shallow excavations is a hazard. If the Fordville soil is used as a site for local roads and streets, the base material needs to be strengthened to help overcome the low strength of this soil. Septic tank absorption fields function well; however, all sanitary facilities are a potential source of pollution to ground water.

Capability unit IIIs-2; the Fordville soil is in Silty range site, and the Renshaw soil is in Shallow to Gravel range site.

FdA—Forman-Aastad loams, 0 to 2 percent slopes. These are deep, well drained and moderately well drained, nearly level soils on uplands. Shallow depressions and few medium to large surface stones are in some areas. The areas of this map unit range from 4 to more than 100 acres in size. They are 65 to 75 percent Forman soil and 20 to 25 percent Aastad soil. The Forman soil is on slight rises. The Aastad soil is in slight depressions. It is subject to frequent flooding of very brief duration. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Forman soil is dark gray loam about 6 inches thick. The subsoil is about 17 inches thick. It is brown, friable clay loam in the upper part and grayish brown, friable, calcareous clay loam in the lower part. The underlying material, to a depth of 60 inches, is light brownish gray, calcareous clay loam. In places, the surface layer is thinner than is typical and has been mixed with material from the subsoil by plowing.

Typically, the surface layer of the Aastad soil is about 17 inches thick. It is dark gray loam about 6 inches thick in the upper part and dark gray clay loam about 11 inches thick in the lower part. The subsoil is grayish brown, firm clay loam about 12 inches thick. The underlying material, to a depth of 60 inches, is light yellowish brown, calcareous loam.

Included in mapping are small areas of Peever, Tonka, and Vallers soils. These soils make up less than 10 percent of any one mapped area. Peever soils are intermingled with the Forman soil and they have more clay. Tonka soils are poorly drained and are in shallow depressions. Vallers soils are poorly drained and are on the edge of depressions.

Permeability in the Forman soil is moderate in the subsoil and moderately slow in the underlying material; in the Aastad soil, it is moderately slow. The available water capacity in the Forman and Aastad soils is high. Fertility in these soils is medium or high, and the content of organic matter is moderate or high.

The shrink-swell potential is moderate in the subsoil and underlying material. Runoff is slow. The Aastad soil has a water table between depths of 3 and 6 feet for short periods in spring.

In most areas, these soils are used for farming. In a few areas, they are in native grass and are used for grazing or hay. These soils have good potential for cultivated crops; for use as tame pasture, hayland, or rangeland; for windbreaks and environmental plantings; and for the development of habitat for openland wildlife. The Forman soil has good potential for the development of habitat for rangeland wildlife, and the Aastad soil has fair potential. The Forman soil has fair potential for building site development, and the Aastad soil has poor potential. These soils have poor potential for most sanitary facilities.

The soils in this unit are well suited to corn, small grains, soybeans, and grasses and legumes for pasture or hay. If these soils are used for crops, maintaining the fertility and tilth of the soils is the main management concern. In areas of the Aastad soil, planting and harvesting commonly are delayed in wet periods. The use of minimum tillage, green manure crops, and grasses and legumes in the cropping system helps to maintain fertility and the organic matter content.

The soils in this unit are well suited to use as tame pasture and hayland. They are suited to all climatically adapted pasture plants. Stocking at the proper rate, rotating grazing, and controlling weeds help to keep pasture in good condition.

These soils are well suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs grow well if the competing vegetation is controlled. Proper site preparation, cultivation, and the use of herbicides help in controlling competing vegetation.

If buildings are constructed on these soils, foundations and footings should be reinforced to prevent structural damage by the shrinking and swelling of the soil. Local roads should be graded and the base material compacted to help prevent damage to the road by frost action and by shrinking and swelling. The Aastad soil is poorly suited to use as septic tank absorption fields because it is subject to flooding and seasonal wetness. If the Forman soil is used for septic tank absorption fields, the absorption area needs to be enlarged because of the slow absorption of liquid waste.

Capability unit I-2; the Forman soil is in Silty range site, the Aastad soil is in Overflow range site.

FdB—Forman-Aastad loams, 1 to 6 percent slopes. These are deep, well drained and moderately well drained, gently undulating soils on uplands. Small depressions are common, and most areas are dissected by shallow drainageways. In a few areas, stones are scattered on the knolls. The areas of this map unit range from 10 to several hundred acres in size. They are about 55 to 65 percent Forman soil and 25 to 30 percent Aastad soil. The Forman soil is on side slopes and knolls. The Aastad soil is on foot slopes and in swales and is subject to frequent flooding of very brief duration. The soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Forman soil is dark gray loam about 6 inches thick. The subsoil is about 17 inches thick. It is brown, friable clay loam in the upper part and grayish brown, friable, calcareous clay loam in the lower part. The underlying material, to a depth of 60 inches, is light brownish gray, calcareous clay loam. In places, the surface layer is thinner than is typical.

Typically, the surface layer of the Aastad soil is about 17 inches thick. It is dark gray loam about 6 inches thick in the upper part and dark gray clay loam about 11 inches thick in the lower part. The subsoil is grayish brown, firm clay loam about 12 inches thick. The underlying material, to a depth of 60 inches, is light yellowish brown, calcareous loam. In places, the surface layer is thicker than is typical.

Included in mapping are small areas of Buse, Flom, Parnell, Peever, Tonka, and Vallers soils. These soils make up less than 15 percent of any one mapped area. Buse soils are on knolls and, unlike the Forman soil, do not have a subsoil. Peever soils are intermingled with the Forman soil, and they have more clay. Flom soils are poorly drained and are in low swales. Parnell and Tonka soils are very poorly drained and poorly drained and are in shallow depressions. Vallers soils are poorly drained and are around the depressions.

In the Forman soil, permeability is moderate in the subsoil and slow in the underlying material. In the Aastad soil, permeability is moderately slow. The available water capacity of the Forman and Aastad soils is high. Fertility is medium or high, and the organic matter content is moderate or high. The shrink-swell potential is moderate in the subsoil and in the underlying material. Runoff is medium. In the Aastad soil, the water table is between depths of 3 and 6 feet for short periods in spring.

In most areas, these soils are used for farming. In a few areas, they are in native grass and are used for grazing or hay. These soils have good potential for cultivated crops; for use as tame pasture, hayland, or rangeland; for windbreaks and environmental plantings; and for the development of habitat for openland and rangeland wildlife. The Forman soil has good potential for the development of habitat for rangeland wildlife, and the Aastad soil has good potential. The Forman soil has fair potential for building site development, and the Aastad soil has poor potential. These soils have poor potential for most sanitary facilities.

The soils in this unit are suited to corn, small grains, soybeans, and grasses and legumes for hay and pasture. If these soils are used for crops, controlling erosion and maintaining fertility are the main management concerns. In areas of the Aastad soil, planting and harvesting commonly are delayed in wet periods. The use of minimum tillage, winter cover crops, and grassed waterways helps to prevent excessive soil loss and to conserve moisture. Returning crop residue and other organic material to the soil helps to improve fertility and tilth and to increase water infiltration.

Using these soils as tame pasture, hayland, or rangeland also is effective in controlling erosion. These soils are suited to all climatically adapted pasture plants. Overgrazing reduces the vegetative cover and increases runoff and erosion. Seeding adapted grasses and using fertilizer can help to establish a good vegetative cover. Proper stocking rates, rotation grazing, weed control, and timely deferment of grazing help to keep pasture in good condition. On rangeland, a planned grazing system that includes proper grazing use and deferred grazing helps to maintain or improve the range condition.

The soils in this unit are well suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees grow well if the competing vegetation is controlled. Good site preparation, cultivation, and the use of herbicides help in controlling competing vegetation. Planting trees on the contour reduces the hazard of erosion.

If buildings are constructed on these soils, foundations and footings should be reinforced and runoff should be diverted from the building site to help prevent structural damage by the shrinking and swelling of the soils. Local roads should be graded and the base material strengthened to prevent damage by frost action and by shrinking and swelling. Seeding adapted grasses in borrow areas helps to prevent gully erosion. The Aastad soil is poorly suited to use as septic tank absorption fields because it is subject to flooding and seasonal wetness. If the Forman soil is used for septic tank absorption fields, the absorption area needs to be enlarged because of the

slow absorption of liquid waste. If the Forman soil is used for sewage lagoons, the surface needs to be shaped. The Aastad soil has few limitations to use as a site for sewage lagoons.

Capability unit IIe-2; the Forman soil is in Silty range site, and the Aastad soil is in Overflow range site.

FdC—Forman-Aastad loams, 3 to 9 percent slopes. These are deep, well drained and moderately well drained, undulating and gently rolling soils on uplands. Small depressions are common, and most areas are dissected by shallow drainageways. In places, a few stones are scattered on the knolls. The areas of this map unit range from 10 to more than 150 acres in size. They are 50 to 60 percent Forman soil and 25 to 30 percent Aastad soil. The Forman soil is on the middle and lower parts of plane or convex side slopes. The Aastad soil is on foot slopes and in shallow swales. It is subject to frequent flooding of very brief duration. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Forman soil is dark gray loam about 6 inches thick. The subsoil is about 17 inches thick. It is brown, friable clay loam in the upper part and grayish brown, friable, calcareous clay loam in the lower part. The underlying material, to a depth of 60 inches, is light brownish gray, calcareous clay loam. In places, the surface layer is thinner because of erosion.

Typically, the surface layer of the Aastad soil is about 17 inches thick. It is dark gray loam about 6 inches thick in the upper part and dark gray clay loam about 11 inches thick in the lower part. The subsoil is grayish brown, firm clay loam about 12 inches thick. The underlying material, to a depth of 60 inches, is light yellowish brown, friable, calcareous loam. In some areas where this soil is on foot slopes, the surface layer is thicker than is typical.

Included in mapping are small areas of Buse, Flom, Parnell, Tonka, and Vallers soils. These soils make up less than 20 percent of any one mapped area. Buse soils are on knolls and, unlike the Forman soil, do not have a subsoil. Flom soils are poorly drained and are in drainageways. Parnell and Tonka soils are very poorly drained and poorly drained and are in shallow depressions. Vallers soils are poorly drained and are around the depressions.

In the Forman soil, permeability is moderate in the subsoil and moderately slow in the underlying material. In the Aastad soil, permeability is moderately slow. The available water capacity of the Forman and Aastad soils is high. Fertility is medium or high, and the organic matter content is moderate to high. The shrink-swell potential is moderate in the subsoil and underlying material. Runoff is medium or high. The Aastad soil has a water table between depths of 3 and 6 feet for short periods in spring.

In most areas, these soils are in native grass and are used as pasture or hayland. In some areas, they are used for farming or as tame pasture and hayland. These soils have good potential for use as rangeland, tame pasture, or hayland; for the development of habitat for openland wildlife; and for windbreaks and environmental plantings. The Forman soil has good potential for the development of habitat for rangeland wildlife, and the Aastad soil has fair potential. The Forman soil has fair potential for building site development, and the Aastad soil has poor potential. These soils have poor potential for most sanitary facilities.

The soils in this unit are well suited to use as rangeland. The natural plant community is a mixture of tall, mid, and short grasses. Maintaining an adequate vegetative cover and ground mulch helps to prevent excessive soil loss and improves the supply of moisture for range plants. Overgrazing rangeland reduces the vegetative cover and causes deterioration of the plant community. The taller, more productive grasses are replaced by less productive short grasses and weeds. A planned grazing system that includes proper grazing use and deferred grazing helps to maintain or improve range condition and to control erosion. Potential sites for stockwater dugouts generally are available in areas of the Aastad, Parnell, and Tonka soils.

These soils are suited to corn, small grains, soybeans, and grasses and legumes for hay and pasture. If these soils are used for crops, controlling erosion and maintaining fertility are the main concerns of management. The use of minimum tillage, crop residue, and grassed waterways helps to prevent the loss of soil and water through runoff. Contour farming and terraces are effective in controlling erosion. Returning crop residue or adding other organic material to the soil helps to improve fertility and tilth and to increase water infiltration. In areas of the Aastad soil, planting and harvesting commonly are delayed in wet periods.

These soils are suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs grow well if the competing vegetation is controlled. Good site preparation, cultivation, and the use of herbicides help in controlling competing vegetation. Planting trees on the contour helps to control erosion and conserve moisture.

If buildings are constructed on these soils, foundations and footings should be reinforced, and runoff should be diverted from the building site to help prevent structural damage by the shrinking and swelling of the soil. Local roads should be constructed on raised and well compacted material to help prevent damage to the road by frost action and by shrinking and swelling.

The Aastad soil is poorly suited to use as septic tank absorption fields because it is subject to flooding. If the Forman soil is used as septic tank absorption fields, the absorption area needs to be enlarged because of the slow absorption of liquid waste. If the Forman soil is

used for sewage lagoons, the surface needs to be shaped. The Aastad soil has few limitations to use as a site for sewage lagoons.

The Forman soil is in capability unit IIIe-1, Silty range site; the Aastad soil is in capability unit IIe-1, Overflow range site.

FdD—Forman-Aastad loams, 4 to 15 percent slopes. These are deep, well drained and moderately well drained, gently sloping to rolling soils on uplands. Slopes generally are short and irregular and are in a complex pattern. Small wet depressions are common throughout the map unit, and most areas are dissected by shallow drainageways. A few stones of variable size are common on the knolls. The areas of this unit range from 10 to several hundred acres in size. They are 45 to 55 percent Forman soil and 25 to 30 percent Aastad soil. The Forman soil is on the middle and upper parts of side slopes and on the broader ridgetops. The Aastad soil is on foot slopes and in swales. It is subject to frequent flooding of brief duration. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Forman soil is dark gray loam about 6 inches thick. The subsoil is about 17 inches thick. It is brown, friable clay loam in the upper part and grayish brown, friable, calcareous clay loam in the lower part. The underlying material, to a depth of 60 inches, is light brownish gray, calcareous clay loam. In areas where this soil has been eroded, the surface layer is thinner than is typical. In places, it is light colored.

Typically, the surface layer of the Aastad soil is about 17 inches thick. It is dark gray loam about 6 inches thick in the upper part and dark gray clay loam about 11 inches thick in the lower part. The subsoil is grayish brown, firm clay loam about 12 inches thick. The underlying material, to a depth of 60 inches, is light yellowish brown, calcareous loam. In places, the surface layer is thicker than is typical, and mottles are at a lesser depth.

Included in mapping are small areas of Buse, Flom, Parnell, Renshaw, Sioux, and Vallers soils. These soils make up less than 20 percent of any one mapped area. Buse soils have a thin surface layer and are on knolls and ridges. Flom soils are poorly drained and are in low swales and shallow drainageways. Parnell soils are very poorly drained and are in depressions. Vallers soils are poorly drained and are around the depressions. Renshaw and Sioux soils are on knolls and are shallow over sand and gravel.

In the Forman soil, permeability is moderate in the subsoil and moderately slow in the underlying material. In the Aastad soil, permeability is moderately slow. The available water capacity of the Forman and Aastad soils is high. Fertility is medium or high, and the organic matter content is moderate or high. The shrink-swell potential is moderate in the subsoil and underlying material. Runoff is medium or rapid. The Aastad soil has a water table between depths of 3 and 6 feet for short periods in spring.

In most areas, these soils are in native grass and are used for grazing or hay. In a few areas, they are used for farming or have been reseeded to grass. The Forman soil has good potential for use as rangeland, tame pasture, and hayland; for windbreaks and environmental plantings; and for the development of habitat for rangeland wildlife. It has fair potential for cultivated crops and for the development of habitat for openland wildlife. The Aastad soil has good potential for cultivated crops; for use as rangeland, tame pasture, and hayland; for windbreaks and environmental plantings; and for the development of habitat for openland wildlife. It has fair potential for the development of habitat for rangeland wildlife. The Forman soil has fair potential for building site development and poor potential for most sanitary facilities. The Aastad soil has poor potential for building site development and for most sanitary facilities.

The soils in this unit are well suited to use as rangeland. The natural plant cover is a mixture of tall, mid, and short grasses. Maintaining an adequate vegetative cover and ground mulch helps to prevent excessive soil loss and improves the supply of moisture for rangeland plants. Overgrazing the rangeland reduces the vegetative cover and causes deterioration of the plant community. The taller, more desirable grasses are replaced by less productive short grasses and weeds. A planned grazing system that includes proper grazing use and deferred grazing helps to maintain or improve range condition and to control erosion. Potential sites for stockwater dugouts are available in areas of the Aastad and Parnell soils.

The soils in this unit are poorly suited to cultivated crops. If the soils are used for crops, the main concerns of management are controlling erosion and maintaining fertility. The use of minimum tillage, close-growing crops, and grassed waterways helps to prevent excessive soil loss. Reseeding cultivated areas to grasses and legumes for pasture and hay also is effective in controlling erosion. In areas where slopes are not too steep, contour farming and terraces are effective in controlling erosion. In some areas of Aastad soils, planting and harvesting commonly are delayed in wet periods.

If these soils are used as tame pasture, proper stocking rates, rotation grazing, and timely deferment of grazing help to reduce runoff, thus preventing excessive soil loss and improving the moisture supply.

These soils are suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs grow well if the competing vegetation is controlled. Good site preparation, cultivation, and the use of herbicides help in controlling competing vegetation. Planting trees on the contour helps to control erosion and conserve moisture.

If buildings are constructed on these soils, foundations and footings should be reinforced, and runoff should be diverted from the building site to help prevent structural

damage by the shrinking and swelling of the soil. Local roads should be constructed on raised and well compacted material to help prevent damage to the road by frost action and by shrinking and swelling. Mulching and seeding adapted grasses help to control roadside erosion and gully erosion in borrow areas.

The Aastad soil is poorly suited to use as septic tank absorption fields because it is subject to flooding and seasonal wetness. If the Forman soil is used as septic tank absorption fields, the absorption area needs to be enlarged because of the slow absorption of liquid waste. The Forman soil generally is too steep for sewage lagoons. The Aastad soil has few limitations to use as a site for sewage lagoons.

The Forman soil is in capability unit IVe-1, Silty range site; the Aastad soil is in capability unit IIe-1, Overflow range site.

FeC—Forman-Aastad extremely stony complex, 0 to 9 percent slopes. This complex consists of a deep, well drained, extremely stony soil and a deep, moderately well drained, nearly level to gently rolling soil. These soils are on uplands. The areas of this map unit range from 5 to 35 acres in size. They are 60 to 70 percent Forman soil and 25 to 30 percent Aastad soil. The Forman soil is in the higher lying level areas and on the middle and upper parts of side slopes and knolls. In areas of the Forman soil, many stones are scattered on the surface and are in the soil. In most places, these stones are more than 10 inches in diameter. There are a few large boulders in some areas. The Aastad soil is on foot slopes and in shallow swales. It is subject to frequent flooding of very brief duration. In some areas of the Aastad soil, a few stones are scattered on the surface. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Forman soil is dark gray, extremely stony loam about 6 inches thick. The subsoil is about 17 inches thick. It is brown, friable clay loam in the upper part and grayish brown, friable, calcareous clay loam in the lower part. The underlying material, to a depth of 60 inches, is light brownish gray, calcareous clay loam. In areas where this soil is on the higher part of ridges, the surface layer and subsoil are thinner than typical.

Typically, the surface layer of the Aastad soil is about 17 inches thick. It is dark gray loam about 6 inches thick in the upper part and dark gray clay loam about 11 inches thick in the lower part. The subsoil is grayish brown, firm clay loam about 12 inches thick. The underlying material, to a depth of 60 inches, is light yellowish brown, calcareous loam. In places, the surface layer is thicker than is typical, and mottles are at a lesser depth.

Included in mapping are small areas of the well drained Buse soils on knolls, the very poorly drained Parnell soils and the poorly drained Tonka soils in depressions, and the poorly drained Flom soils in shallow drainageways. Also included are small areas of the poorly drained Vallers soils around the depressions. These soils make up less than 10 percent of any one mapped area.

In the Forman soil, permeability is moderate in the subsoil and moderately slow in the underlying material. In the Aastad soil, permeability is moderately slow. The available water capacity in these soils is high. Fertility is medium or high, and the organic matter content is moderate or high. The shrink-swell potential is moderate in the subsoil and underlying material. Runoff is slow or medium. The Aastad soil has a water table between depths of 3 and 6 feet for short periods in spring.

In most areas, these soils are in native grass and are used for grazing. Although the Aastad soil is well suited to crops and other agricultural uses, the Forman soil, because it is extremely stony, determines the suitability of this unit for these uses. The soils in this unit have good potential for use as rangeland. The Forman soil has good potential for the development of habitat for rangeland wildlife, and the Aastad soil has fair potential. These soils have poor potential for cultivated crops, for use as tame pasture and hayland, for windbreaks and environmental plantings, and for the development of habitat for openland wildlife. These soils have poor potential for building site development and for most sanitary facilities because of the stones in and on the soil.

This unit is best suited to use as rangeland. The natural plant community is a mixture of tall, mid, and short grasses. Maintaining an adequate vegetative cover and ground mulch helps to prevent excessive soil loss and improves the supply of moisture for range plants. Overgrazing causes deterioration of the plant community. The taller, more productive grasses are replaced by less productive short grasses and other undesirable plants. A planned grazing system that includes proper grazing and deferred grazing helps to maintain or improve range condition and to control erosion.

Because the Forman soil in this unit is extremely stony, this unit generally is not suitable for farming or for use as tame pasture and hayland.

The extreme stoniness of the Forman soil also generally makes this unit unsuitable for use as sites for windbreaks and environmental plantings if the trees and shrubs are planted using machinery. However, this unit is well suited to adapted trees and shrubs that are planted by hand and given special care.

This unit is poorly suited to building site development because the Forman soil is extremely stony and the Aastad soil is subject to flooding. If buildings are constructed on the Forman soil, the foundations and footings should be reinforced to help prevent structural damage by the shrinking and swelling of the soil. The stones are a severe hindrance in excavating or shaping the surface. Local roads should be graded and the base material compacted to help prevent road damage by

frost action and by shrinking and swelling. The stones also are a severe hindrance in grading or shaping roads.

The Aastad soil is poorly suited to use as septic tank absorption fields because it is subject to flooding and seasonal wetness. If the Forman soil is used as septic tank absorption fields, a large absorption area is needed because liquid wastes are absorbed slowly. However, installing septic tank absorption fields in areas of the Forman soil is difficult because of the extreme stoniness. The extreme stoniness of the Forman soil also severely hinders the construction of sewage lagoons.

Capability unit VIIs-1; the Forman soil is in Silty range site, and the Aastad soil is in Overflow range site.

FgC—Forman-Buse loams, 6 to 9 percent slopes. These are deep, well drained, moderately sloping soils on uplands. A few stones are scattered on the surface of some ridges. The areas of this map unit range from 5 to more than 100 acres in size. They are 45 to 55 percent Forman soil and 25 to 30 percent Buse soil. The Forman soil is on the middle and lower parts of side slopes, and the Buse soil is on ridges and knolls. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Forman soil is dark gray loam about 6 inches thick. The subsoil is about 17 inches thick. It is brown, friable clay loam in the upper part and grayish brown, friable, calcareous clay loam in the lower part. The underlying material, to a depth of 60 inches, is light brownish gray, calcareous clay loam. In places, the surface layer is thinner due to erosion.

Typically, the surface layer of the Buse soil is dark gray loam about 7 inches thick. The underlying material, to a depth of about 22 inches, is light brownish gray, friable, calcareous clay loam. Below that, to a depth of 60 inches, it is light gray, calcareous clay loam. In cultivated areas where part or all of the original surface layer has been removed through erosion and part has been mixed with the underlying material, the present surface layer is light colored.

Included in mapping are small areas of Aastad, Flom, Tonka, and Vallers soils. These soils make up less than 25 percent of any one mapped area. Aastad soils are moderately well drained and are on foot slopes and in swales. Flom soils are poorly drained and are in shallow drainageways. Tonka soils are poorly drained and are in shallow depressions. Vallers soils are poorly drained and are around the depressions.

In the Forman soil, permeability is moderate in the subsoil and moderately slow in the underlying material. In the Buse soil, permeability is moderately slow. Fertility in the Forman soil is medium or high, and in the Buse soil it is low or medium. The organic matter content in the Forman soil is medium to high, and in the Buse soil it is medium or low. The available water capacity of the Forman and Buse soils is high. The shrink-swell potential is moderate in the subsoil or underlying material of these soils. Runoff is medium or rapid.

In most areas, these soils are used for farming. In a few areas, they are in native grass and are used for grazing or hay. In some areas, they are used as pasture or for hay. The soils in this unit have fair potential for cultivated crops. The Forman soil has good potential for use as tame pasture, hayland, or rangeland; for windbreaks and environmental plantings; and for the development of habitat for openland and rangeland wildlife. The Buse soil has fair potential for these uses. These soils have fair potential for building site development and poor potential for most sanitary facilities.

The soils in this unit are better suited to small grains than to row crops. The main concerns of management are controlling erosion and maintaining fertility. The use of minimum tillage and crop residue helps to control erosion. Returning crop residue and adding other organic material to the soil and the use of grasses and legumes in the cropping system help to improve fertility and increase water infiltration.

Using these soils as tame pasture or hayland also is effective in controlling runoff and erosion. These soils are suited to all climatically adapted pasture plants. Maintaining an adequate vegetative cover helps to reduce runoff, thus preventing excessive soil loss and improving the moisture supply. Stocking at the proper rate, rotating grazing, applying fertilizer, and controlling weeds help to keep pasture in good condition.

The Forman soil is suited to use as sites for windbreaks and environmental plantings. The Buse soil is poorly suited to this use. All climatically adapted trees and shrubs grow well on the Forman soil, but their rate of growth and survival on the Buse soil is low. Erosion is a severe hazard in preparing sites and cultivating trees. Planting trees on the contour helps to control erosion and conserve moisture.

If buildings are constructed on these soils, foundations and footings should be reinforced to help prevent structural damage by the shrinking and swelling of the soil. Local roads should be graded to shed water, and the base material should be compacted to help prevent road damage by frost action and by shrinking and swelling. Septic tank absorption fields on these soils need to be large because of the restricted permeability of the soils. These soils generally are too steep for sewage lagoons. Suitable sites for sewage lagoons are in some areas of the less sloping soils that are included with the Forman and Buse soils in this map unit.

The Forman soil is in capability unit IIIe-1, Silty range site; and the Buse soil is in capability unit IVe-2, Thin Upland range site.

FgE—Forman-Buse loams, 15 to 25 percent slopes. These are deep, well drained, moderately steep soils on upland knolls, ridges, and side slopes. In some areas, a few stones are scattered on the knolls and ridgetops.

Some areas are dissected by shallow drainageways, and small wet depressions are common throughout the map unit. The areas of this map unit are irregular in shape and range from about 10 to several hundred acres in size. They are 40 to 50 percent Forman soil and 25 to 35 percent Buse soil. The Forman soil is on the middle and upper parts of side slopes and on the broader ridgetops. The Buse soil is on ridges, knolls, and the upper part of side slopes of drainageways. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Forman soil is dark gray loam about 6 inches thick. The subsoil is about 17 inches thick. It is brown, friable clay loam in the upper part and grayish brown, friable, calcareous clay loam in the lower part. The underlying material, to a depth of 60 inches, is light brownish gray, calcareous clay loam. In areas where this soil is in high positions on the landscape, the surface layer and subsoil are thinner than typical, and lime is nearer to the surface. The surface layer is thicker in areas where this soil is on the lower part of side slopes.

Typically, the surface layer of the Buse soil is dark gray loam about 7 inches thick. The underlying material, to a depth of about 22 inches, is light brownish gray, friable, calcareous clay loam. Below that, to a depth of 60 inches, it is light gray, calcareous clay loam. In places, the surface layer is thinner than is typical, or it has been removed through erosion.

Included in mapping are small areas of Aastad, Flom, Parnell, Renshaw, Sioux, and Vallers soils. These soils make up less than 25 percent of any one mapped area. The moderately well drained Aastad soils are on foot slopes and in swales. Flom soils are poorly drained and are in shallow drainageways and low swales. Parnell soils are very poorly drained and are in sloughs or small wet depressions. Renshaw and Sioux soils are underlain by gravel; they are on the top of knolls and ridges in areas where there are pockets of gravel. Vallers soils are poorly drained and are in low areas around and between depressions.

In the Forman soil, permeability is moderate in the subsoil and moderately slow in the underlying material. In the Buse soil, permeability is moderately slow. Fertility in the Forman soil is medium or high, and in the Buse soil it is low or medium. The organic matter content in the Forman soil is moderate or high, and in the Buse soil it is moderate or low. The available water capacity of the Forman and Buse soils is high. The shrink-swell potential is moderate in the subsoil and underlying material of these soils. Runoff is medium or rapid.

In most areas, these soils are in native grass and are used for grazing. They have poor potential for cultivated crops, for windbreaks and environmental plantings, and for the development of habitat for openland wildlife. The Forman soil has good potential for use as rangeland, tame pasture, and hayland and for the development of habitat for rangeland wildlife; the Buse soil has fair potential for these uses. These soils have poor potential for building site development and sanitary facilities.

The soils in this unit are best suited to use as rangeland. The natural plant cover is a mixture of tall, mid, and short grasses. Maintaining an adequate vegetative cover and ground mulch helps to prevent excessive soil loss and improves the supply of moisture for rangeland plants. Overgrazing pasture causes deterioration of the plant community; the taller, more productive grasses are replaced by less productive, undesirable grasses. A planned grazing system that includes proper grazing use, uniform grazing distribution, timely deferment of grazing, and brush and weed control helps to keep rangeland in good condition. Potential sites for stockwater dugouts are available in areas of the Aastad, Flom, and Parnell soils, which are included with the Buse and Forman soils in this unit.

Because the soils in this unit are steep, they generally are not suitable for farming or for use as tame pasture and hayland.

The steepness of these soils also generally makes them unsuitable for use as sites for windbreaks and environmental plantings if the trees and shrubs are planted using machinery. However, the Forman soil is suited to wildlife and beautification plantings that are hand planted and given special care.

If these soils are used for building site development, buildings should be constructed in the less sloping areas. Foundations and footings should be reinforced, and runoff should be diverted from the buildings to help prevent structural damage by the shrinking and swelling of the soil. Local roads should be graded and the base material compacted to help prevent damage to the road by frost action and by shrinking and swelling. Mulching and seeding adapted grasses help to control roadside erosion and prevent gully erosion in borrow areas.

If these soils are used as sites for septic tank absorption fields, the absorption area needs to be enlarged because the permeability of the soils is restricted. The moderately steep slopes make the construction of sanitary facilities difficult.

Capability unit VIe-1; the Forman soil is in Silty range site, and the Buse soil is in Thin Upland range site.

FhE—Forman-Buse extremely stony loams, 9 to 40 percent slopes. These are deep, well drained, extremely stony, rolling to steep soils on uplands. In some areas, mainly on the Buse soil, the stones are as much as 5 feet in diameter and are 1 to 5 feet apart (fig. 6); these areas are as much as 4 acres in size and are scattered throughout the map unit. Shallow depressions are common, and some areas are dissected by drainageways. The areas of this unit are irregular in shape and range from 4 to more than 200 acres in size. They are 35 to 45 percent Forman soil and 30 to 40 percent Buse soil. The Forman soil is on the side slopes of

Figure 6.—An area of Forman-Buse extremely stony loams, 9 to 40 percent slopes.

ridges and hills. The Buse soil is on ridges and knolls. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Forman soil is dark gray, extremely stony loam about 6 inches thick. The subsoil is about 17 inches thick. It is brown, friable clay loam in the upper part and grayish brown, friable, calcareous clay loam in the lower part. The underlying material, to a depth of 60 inches, is light brownish gray, calcareous clay loam. In areas where this soil is in higher positions on the landscape, the surface layer and subsoil are thinner than is typical, and lime is at a lesser depth. Where this soil is on the lower part of side slopes, the surface layer is thicker than is typical, and lime is at a greater depth.

Typically, the surface layer of the Buse soil is dark gray, extremely stony loam about 7 inches thick. The underlying material, to a depth of about 22 inches, is light brownish gray, friable, calcareous clay loam. Below that, to a depth of 60 inches, it is light gray, calcareous clay loam.

Included in mapping are small areas of Aastad, Barnes, Parnell, Sioux, and Vallers soils. These soils make up less than 25 percent of any one mapped area. Aastad soils are the most extensive of these soils. They are moderately well drained and are on foot slopes and in swales. Barnes soils have less clay in the subsoil and are intermingled with the Forman soil. Parnell soils are very poorly drained and are in sloughs and wet depressions. Sioux soils are shallow to gravel; they are on ridgetops in areas where there are small pockets of gravel. Vallers soils are poorly drained and are in low areas around and between depressions.

In the Forman soil, permeability is moderate in the subsoil and moderately slow in the underlying material. In the Buse soil, permeability is moderately slow. Fertility in the Forman soil is medium or high, and in the Buse soil it is low or medium. The organic matter content in the Forman soil is moderate or high, and in the Buse soil it is moderate or low. The available water capacity of the Forman and Buse soils is high. The shrink-swell potential is moderate in the subsoil or underlying material of these soils. Runoff is medium or rapid.

In most areas, these soils are in native grass and are used for grazing. The Forman soil has good potential for use as rangeland and for the development of habitat for

rangeland wildlife. The Buse soil has fair potential for these uses. These soils have poor potential for farming, for use as tame pasture and hayland, for windbreaks and environmental plantings, and for the development of habitat for openland wildlife. They have poor potential for building site development and sanitary facilities.

This unit is best suited to use as rangeland. The natural plant cover is a mixture of tall, mid, and short grasses. Maintaining an adequate vegetative cover and ground mulch helps to prevent excessive soil loss and improves the supply of moisture for range plants. Overgrazing rangeland reduces the vegetative cover and causes deterioration of the plant community. The taller, more desirable grasses are replaced by less productive short grasses and undesirable plants. A planned grazing system that includes proper grazing use and deferred grazing helps to maintain or improve the range condition. Potential sites for stockwater dugouts are available in areas of the Aastad and Parnell soils, which are included with the Forman and Buse soils in this unit.

The soils in this unit are too stony and too steep for farming or for use as tame pasture and hayland.

These soils also are too stony and too steep for use as sites for windbreaks if the trees and shrubs commonly are planted using machinery. However, the Forman soil is suited to wildlife and beautification plantings that are hand planted and given special care.

These soils are too stony and generally are too steep for building site development and sanitary facilities. Sites for buildings and sanitary facilities should be located on adjacent soils.

Capability unit VIIs-1; the Forman soil is in Silty range site, the Buse soil is in Thin Upland range site.

HaD—Hattie clay loam, 9 to 15 percent slopes. This is a deep, well drained, strongly sloping soil on convex ridgetops, knolls, and short side slopes. Some areas are dissected by drainageways. In some areas, a few stones are scattered on the surface. The areas are irregular in shape and range from 4 to 100 acres in size.

Typically, the surface layer is dark gray clay loam about 7 inches thick. The subsoil is firm, calcareous clay about 29 inches thick. The upper part of the subsoil is grayish brown, and the lower part is light brownish gray. The underlying material, to a depth of 60 inches, is light brownish gray, calcareous clay. In cultivated areas where the original surface layer has been mixed with material from the subsoil by plowing, the present surface layer is grayish brown.

Included in mapping are small areas of Aastad and Peever soils. These soils make up less than 15 percent of any one mapped area. The moderately well drained Aastad soils are in shallow swales. Peever soils do not have lime in the upper part of the soil, are on the lower part of side slopes, and are intermingled with the Hattie soil.

Permeability is slow. The available water capacity is moderate or high. Fertility is medium, and the organic matter content is moderate. The shrink-swell potential is high. Runoff is medium to rapid. This soil is easy to till, but tilth deteriorates if this soil is farmed when wet. Moisture is released slowly to plants.

In most areas, this soil is used for farming. In some areas, it is in native grass and is used for grazing and hay. This soil has good potential for use as tame pasture, hayland, and rangeland and for the development of habitat for rangeland wildlife. This soil has fair potential for crops and for windbreaks and environmental plantings. It has poor potential for the development of habitat for openland wildlife and for building site development and sanitary facilities.

This soil is not well suited to cultivated crops. If this soil is used for crops, controlling erosion and maintaining fertility and tilth are the main concerns of management. The use of minimum tillage, close-growing crops, and grasses and legumes in the cropping system helps to control erosion. Returning crop residue or adding other organic material to the soil helps to improve fertility, maintain tilth, and increase water infiltration. Terraces and contour farming are effective in controlling erosion.

Using this soil as tame pasture and hayland also is effective in controlling erosion. This soil is suited to most climatically adapted pasture plants. Overstocking tame pasture reduces the vegetative cover and increases runoff and erosion. Stocking at the proper rate, rotating grazing, controlling weeds, and deferring grazing help to keep pasture in good condition.

This soil is suitable for use as sites for windbreaks and environmental plantings. Most climatically adapted trees and shrubs grow well if the competing vegetation is controlled. Good site preparation, cultivation, and the use of herbicides help in controlling competing vegetation. Planting trees on the contour helps to conserve moisture and control erosion.

If buildings are constructed on this soil, foundations and footings should be reinforced to help prevent structural damage by the shrinking and swelling of the soil. If this soil is used as a site for local roads and streets, the base material should be strengthened to help overcome the low strength and high shrink-swell potential of the soil.

If this soil is used as a site for septic tank absorption fields, the absorption area needs to be enlarged to help overcome the slow absorption of liquid wastes. This soil can be used as a site for sewage lagoons; however, the surface needs to be leveled because of the slope.

Capability unit IVe-5; Clayey range site.

HaE—Hattie clay loam, 15 to 40 percent slopes. This is a deep, well drained, moderately steep and steep soil on upland ridgetops and side slopes. In many areas, this soil is on side slopes of long drainageways that dissect the uplands. In some areas, a few stones are

scattered on the surface. The areas generally are long and narrow and range from 4 to 250 acres in size.

Typically, the surface layer is dark gray clay loam about 7 inches thick. The subsoil is firm, calcareous clay about 29 inches thick. The upper part of the subsoil is grayish brown, and the lower part is light brownish gray. The underlying material, to a depth of 60 inches, is light brownish gray, calcareous clay. In places, the surface layer is thicker than is typical. In some areas, the surface layer is thinner than is typical, or it has been removed through erosion.

Included in mapping and making up less than 15 percent of any one mapped area are small areas of Aastad, LaDelle, and Peever soils. The moderately well drained Aastad soils are on foot slopes and in swales. LaDelle soils are on bottom lands in the wider draws along drainageways. Peever soils do not have lime in the upper part of the soil and are intermingled with the Hattie soil.

Permeability is slow. The available water capacity is moderate or high. Fertility is medium, and the content of organic matter is moderate. The shrink-swell potential is high. Runoff is rapid. Moisture is released slowly to plants.

In most areas, this soil is in native grass and is used for grazing. This soil has good potential for use as rangeland and for the development of habitat for rangeland wildlife. It has poor potential for crops, for use as tame pasture and hayland, for windbreaks and environmental plantings, and for the development of habitat for openland wildlife. It also has poor potential for building site development and sanitary facilities.

This soil is best suited to use as rangeland. The natural plant cover is a mixture of tall, mid, and short grasses. Maintaining an adequate vegetative cover and ground mulch helps to prevent soil loss and increases the supply of moisture for rangeland plants. Overgrazing rangeland reduces the vegetative cover and causes deterioration of the plant community. The taller, more desirable grasses are replaced by less productive short grasses. A planned grazing system that includes proper grazing use and deferred grazing helps to maintain or improve the range condition and to control erosion. Potential sites for stockwater dugouts commonly are available along drainageways in areas of the LaDelle soil, which is included with this Hattie soil in mapping.

In most areas, this soil is not suitable for farming because of the steep slopes.

This soil is not suited to use as sites for windbreaks if the trees and shrubs commonly are planted by machinery. It can be used for adapted trees and shrubs that are planted by hand and given special care.

This soil is poorly suited to building site development and sanitary facilities because of the high shrink-swell potential and steep slopes. If road construction on this soil is necessary, the base material will need to be strengthened to help prevent damage to the road by the shrinking and swelling of the soil.

Capability unit VIe-3; Clayey range site.

HbB—Heimdal-Sisseton loams, 2 to 6 percent slopes. These are deep, well drained, gently undulating soils on uplands. A few shallow depressions are in some areas. In places, stones and cobblestones are scattered on the surface. The areas of this map unit range from 5 to several hundred acres in size. They are 45 to 55 percent Heimdal soil and 25 to 35 percent Sisseton soil. The Heimdal soil is on the middle and lower parts of plane or convex side slopes. The Sisseton soil is on convex knolls and on the upper part of side slopes. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Heimdal soil is dark gray loam about 8 inches thick. The subsoil is very friable loam about 14 inches thick. The upper part of the subsoil is dark grayish brown, and the lower part is brown. The underlying material, to a depth of 60 inches, is light gray and pale yellow, calcareous loam. In some cultivated areas where the original surface layer has been mixed with material from the subsoil by plowing, the present surface layer is grayish brown.

Typically, the surface layer of the Sisseton soil is light brownish gray, calcareous loam about 7 inches thick. The underlying material, to a depth of 17 inches, is light gray, very friable, calcareous loam. Below that, to a depth of 60 inches, it is pale yellow, very friable, calcareous loam. In places, the surface layer is sandy loam, and strata of loamy fine sand are in the upper part of the soil.

Included in mapping are small areas of the moderately well drained Svea soils and the poorly drained Tonka and Vallers soils. These soils make up less than 20 percent of any one mapped area. Svea soils have a thicker surface layer than Heimdal and Sisseton soils. They are on the lower part of foot slopes and in swales. Tonka soils are in shallow depressions. Vallers soils are around the depressions.

In the Heimdal soil, fertility is medium or high, and in the Sisseton soil it is low. The organic matter content in the Heimdal soil is moderate or high, and in the Sisseton soil it is low. Permeability in these soils is moderate. The available water capacity is high. Runoff is medium.

In most areas, these soils are used for farming. In a few areas, they are in native grass and are used for grazing or hay. These soils have good potential for cultivated crops. The Heimdal soil has good potential for use as tame pasture, hayland, and rangeland; for windbreaks and environmental plantings; and for the development of habitat for rangeland and openland wildlife. The Sisseton soil has fair potential for these uses. These soils have fair potential for building site development and sanitary facilities.

These soils are suited to corn, small grains, and grasses and legumes for hay and pasture. If these soils are used for crops, controlling water erosion and soil blowing and maintaining fertility are the main manage-

ment concerns. The high content of lime in the surface layer of the Sisseton soil restricts the availability of some plant nutrients. Minimum tillage, returning crop residue to the soil, and the use of close-growing crops help to control water erosion and soil blowing. Stripcropping and field windbreaks also help to control soil blowing. Including grasses and legumes in the cropping system, applying fertilizer to the soil, and regularly adding other organic material to the soil help to improve fertility and increase the organic matter content.

Using these soils as tame pasture or hayland also is effective in controlling water erosion and soil blowing. These soils are suited to all climatically adapted pasture plants. Maintaining an adequate vegetative cover helps to reduce runoff, thus preventing excessive soil loss and improving the moisture supply. Stocking at the proper rate, rotating grazing, and deferring grazing help to keep pasture in good condition.

These soils are suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs grow well on the Heimdal soil. The high content of lime in the Sisseton soil restricts the growth of trees and shrubs. Leaving the site fallow for a year prior to planting helps to eliminate grasses and weeds and to conserve moisture. Competing vegetation can be controlled through cultivation and the use of herbicides.

If buildings are constructed on these soils, foundations and footings should be reinforced to help prevent structural damage resulting from the low strength of these soils. Local roads should be constructed on raised and well compacted material to help prevent damage to the road resulting from frost action and low strength. Septic tank absorption fields function well on these soils. If these soils are used as a site for sewage lagoons, the surface needs to be leveled in some areas. However, the excess seepage in these soils generally makes them unsuitable for use as sites for sewage lagoons.

Capability unit IIe-2; the Heimdal soil is in Silty range site, the Sisseton soil is in Thin Upland range site.

HbC—Heimdal-Sisseton loams, 6 to 9 percent slopes. These are deep, well drained, moderately sloping soils on uplands. Some areas are dissected by shallow drainageways. In places, a few stones and cobblestones are scattered on the surface. The areas of this map unit range from 4 to 135 acres in size. They are 40 to 50 percent Heimdal soil and 35 to 45 percent Sisseton soil. The Heimdal soil is on the middle and lower parts of plane or convex side slopes. The Sisseton soil is on narrow convex ridges and the upper part of side slopes of some drainageways. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Heimdal soil is dark gray loam about 8 inches thick. The subsoil is very friable loam about 14 inches thick. The upper part of the subsoil is dark grayish brown, and the lower part is brown. The underlying material, to a depth of 60 inches, is light gray and pale yellow, calcareous loam. In some cultivated areas where the original surface layer has been mixed with material from the subsoil by plowing, the present surface layer is grayish brown.

Typically, the surface layer of the Sisseton soil is light brownish gray, calcareous loam about 7 inches thick. The underlying material, to a depth of 17 inches, is light gray, very friable, calcareous loam. Below that, to a depth of 60 inches, it is pale yellow, very friable, calcareous loam. In places, the surface layer is sandy loam, and strata of loamy fine sand are in the upper part of the soil.

Included in mapping are small areas of the moderately well drained Svea soils and the poorly drained Tonka and Vallers soils. These soils make up less than 15 percent of any one mapped area. Svea soils are on foot slopes and in swales. Tonka soils are in shallow depressions. Vallers soils are around the depressions and in low swales.

In the Heimdal soil, fertility is medium or high, and in the Sisseton soil it is low. The organic matter content in the Heimdal soil is moderate or high, and in the Sisseton soil it is low. Permeability in these soils is moderate. The available water capacity is high. Runoff is medium or rapid.

In most areas, these soils are used for farming. In a few areas, they are in native grass and are used for grazing or for hay. These soils have fair potential for cultivated crops. The Heimdal soil has good potential for use as tame pasture, hayland, and rangeland; for windbreaks and environmental plantings; and for the development of habitat for rangeland and openland wildlife. The Sisseton soil has fair potential for these uses. These soils have fair potential for building site development and sanitary facilities.

These soils are suited to corn, small grains, and grasses and legumes for pasture and hay. If these soils are used for crops, the main concerns of management are controlling water erosion and soil blowing and maintaining fertility. Close-growing crops, crop residue management, and minimum tillage help to control water erosion and soil blowing and to conserve moisture. Contour farming and terracing also are effective in controlling erosion. Including grasses and legumes in the cropping system helps to improve fertility and the organic matter content.

Using these soils as tame pasture and hayland is effective in controlling water erosion and soil blowing. These soils are suited to most climatically adapted pasture plants. Stocking at the proper rate, rotating grazing, controlling weeds, seeding adapted grasses, and deferring grazing help to keep pasture in good condition.

These soils are well suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs grow well on the Heimdal soil. The high content of lime in the Sisseton soil restricts the growth of trees and shrubs. Leaving the site fallow for a

year prior to planting helps to eliminate grasses and weeds and to conserve moisture. Planting trees on the contour helps to control erosion and conserve moisture.

If buildings are constructed on these soils, foundations and footings should be reinforced to help prevent structural damage resulting from the low strength of the soils. Because of the low strength of these soils, the base material for local roads needs to be strengthened. Seeding adapted grasses helps to control roadside erosion and prevent gully erosion in borrow areas. Septic tank absorption fields function well on these soils. If these soils are used as a site for sewage lagoons, the surface needs to be leveled. However, the excess seepage in these soils generally makes them unsuitable for use as sites for sewage lagoons.

Capability unit IIIe-1; the Heimdal soil is in Silty range site, the Sisseton soil is in Thin Upland range site.

HcA—Heimdal-Svea loams, 0 to 2 percent slopes. These are deep, well drained and moderately well drained, nearly level soils on broad, smooth uplands. The areas of this map unit are irregular in shape and range from 4 to several hundred acres in size. They are 65 to 75 percent Heimdal soil and 20 to 30 percent Svea soil. The Heimdal soil is on very slight rises. The Svea soil is in slight depressions and frequently is flooded for a very brief period. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Heimdal soil is dark gray loam about 8 inches thick. The subsoil is very friable loam about 14 inches thick. The upper part of the subsoil is dark grayish brown, and the lower part is brown. The underlying material, to a depth of 60 inches, is light gray and pale yellow, calcareous loam.

Typically, the surface layer of the Svea soil is dark gray loam about 13 inches thick. The subsoil is friable loam about 15 inches thick. The upper part of the subsoil is dark grayish brown, and the lower part is grayish brown. The underlying material, to a depth of 60 inches, is light brownish gray, calcareous loam; strata of sandy loam are in the lower part. In places, the surface layer and subsoil have more silt and less sand than is typical.

Included in mapping are small areas of the well drained Poinsett soils and the poorly drained Tonka and Vallers soils. Poinsett soils are intermingled with the Heimdal soil and have more silt and less sand. Tonka soils are in shallow depressions. Vallers soils are on the edge of depressions.

Permeability in the Heimdal soil is moderate. In the Svea soil, permeability is moderate in the upper part and moderately slow in the lower part. The shrink-swell potential in the Heimdal soil is low, and in the Svea soil it is moderate in the subsoil and underlying material. The available water capacity in these soils is high. Fertility is medium to high, and the organic matter content is moderate or high. Runoff is slow. The Svea soil has a water table at a depth of 4 to 6 feet in spring.

In most areas, these soils are used for farming. These soils have good potential for cultivated crops; for use as tame pasture, hayland, and rangeland; for windbreaks and environmental plantings; and for the development of habitat for openland wildlife. The Svea soil has fair potential for the development of habitat for rangeland wildlife. The Heimdal soil has fair potential for most sanitary facilities and for building site development, and the Svea soil has poor potential for these uses.

These soils are well suited to corn, soybeans, small grains, and grasses and legumes for tame pasture and hay. If these soils are used for crops, maintaining tilth and fertility is the main management concern. Minimum tillage, returning crop residue to the soil, and using grasses and legumes in the cropping system help to maintain fertility and tilth. In areas of the Svea soil, planting and harvesting commonly are delayed in wet periods.

These soils are suited to use as tame pasture and hayland. They are suited to all climatically adapted pasture plants. Stocking at the proper rate, rotating grazing, applying fertilizer, and controlling weeds help to keep pasture in good condition.

These soils are suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs grow well. Leaving the site fallow for a year prior to planting helps to eliminate grasses and weeds and to conserve moisture. Competing vegetation can be controlled through cultivation and the use of herbicides.

The Svea soil is poorly suited to building site development because it is subject to flooding and seasonal wetness. If the Heimdal soil is used as a site for buildings, the foundations and footings should be reinforced to help overcome the low strength of the soil. Local roads should be constructed on raised and well compacted material to help prevent damage to the road by frost action. The Svea soil should not be used as a site for septic tank absorption fields because it is subject to flooding and seasonal wetness. The Heimdal soil can be used as a site for septic tank absorption fields. If the Heimdal soil is used for sewage lagoons, seepage needs to be reduced by sealing the bottom and sides of the lagoon. The Svea soil has few limitations for sewage lagoons.

Capability unit I-2; the Heimdal soil is in Silty range site, and the Svea soil is in Overflow range site.

HcB—Heimdal-Svea loams, 2 to 6 percent slopes. These are deep, well drained and moderately well drained, gently undulating soils on uplands. Small wet depressions are in most areas. In places, stones and cobblestones are on the surface. The areas of this map unit are irregular in shape and range from 5 to several hundred acres in size. They are 55 to 65 percent Heimdal soil and 20 to 30 percent Svea soil. The Heimdal soil

is on plane or convex knolls and on the upper part of side slopes. The Svea soil is on the lower part of side slopes and in swales. It is subject to frequent flooding of very brief duration. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Heimdal soil is dark gray loam about 8 inches thick. The subsoil is very friable loam about 14 inches thick. The upper part of the subsoil is dark grayish brown, and the lower part is brown. The underlying material, to a depth of 60 inches, is light gray and pale yellow, calcareous loam. In places where the original surface layer has been mixed with material from the subsoil by plowing, the present surface layer is thinner and lighter in color.

Typically, the surface layer of the Svea soil is dark gray loam about 13 inches thick. The subsoil is friable loam about 15 inches thick. The upper part of the subsoil is dark grayish brown, and the lower part is grayish brown. The underlying material, to a depth of 60 inches, is light brownish gray, calcareous loam; strata of sandy loam are in the lower part. In places, the surface layer and subsoil have more silt than is typical.

Included in mapping are small areas of Barnes, Parnell, Sisseton, Tonka, and Vallers soils. These soils make up less than 15 percent of any one mapped area. Barnes soils are intermingled with the Heimdal soil and have more clay. Sisseton soils have a light-colored surface layer and are on knolls. Parnell and Tonka soils are poorly drained and are in shallow depressions. Vallers soils are poorly drained and are in low areas around and between depressions.

Permeability in the Heimdal soil is moderate. In the Svea soil, permeability is moderate in the upper part and moderately slow in the lower part. The shrink-swell potential in the Heimdal soil is low, and in the Svea soil it is moderate in the subsoil and underlying material. The available water capacity in these soils is high. Fertility is medium to high, and the organic matter content is moderate or high. Runoff is medium. The Svea soil has a water table at a depth of 4 to 6 feet in spring.

In most areas, these soils are used for farming (fig. 7). In a few areas, they are in native grass and are used for grazing or hay. These soils have good potential for cultivated crops; for use as tame pasture, hayland, and rangeland; for windbreaks and environmental plantings; and for the development of habitat for openland wildlife. The Svea soil has fair potential for the development of habitat for rangeland wildlife. The Heimdal soil has fair potential for building site development and sanitary facilities, and the Svea soil has poor potential.

These soils are suited to corn, small grains, and grasses and legumes for tame pasture and hay. If these soils are used for crops, controlling erosion and maintaining fertility are the main concerns of management. Minimum tillage and the use of close-growing crops help to control erosion and conserve moisture. Returning crop

Figure 7.—Heimdal-Svea loams, 2 to 6 percent slopes, are suited to corn.

Figure 8.—An area of LaDelle silt loam on bottom lands.

residue to the soil and including grasses or legumes in the cropping system help to maintain fertility and increase the organic matter content. In areas of Svea soil, planting and harvesting commonly are delayed in wet periods.

Using these soils as tame pasture and hayland also is effective in controlling erosion. These soils are suited to all climatically adapted pasture plants. Stocking at the proper rate, rotating grazing, applying fertilizer, controlling weeds, and deferring grazing help to keep pasture in good condition.

These soils are suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs grow well. Leaving the site fallow for a year prior to planting helps to eliminate grasses and weeds and to conserve moisture. Competing vegetation can be controlled through cultivation and the use of herbicides.

The Svea soil is poorly suited to building site development because it is subject to flooding and seasonal wetness. If the Heimdal soil is used as a site for buildings, the foundations and footings should be reinforced to help overcome the low strength of the soil, and runoff should be diverted from the site. Because these soils have low strength, the base material for roads needs to be strengthened.

The Svea soil should not be used as a site for septic tank absorption fields because it is subject to flooding and seasonal wetness. The Heimdal soil can be used as a site for septic tank absorption fields. If the Heimdal soil is used for sewage lagoons, the surface needs to be shaped. The excessive seepage in the Heimdal soil can be reduced by sealing the bottom and sides of the sewage lagoon. The Svea soil has few limitations for sewage lagoons.

Capability unit IIe-2; Silty range site.

La—LaDelle silt loam. This is a deep, nearly level, moderately well drained soil on stream terraces and bottom lands (fig. 8). The terraces are rarely flooded, and the bottom lands are frequently flooded for a brief period. Most areas are dissected by major drainageways. The areas are irregular in shape and range from 3 to several hundred acres in size.

Typically, the surface layer is about 18 inches thick. It is dark gray silt loam about 6 inches thick in the upper part and dark gray, friable, calcareous silt loam about 12 inches thick in the lower part. The underlying material, to a depth of 60 inches, is gray, calcareous silty clay loam. In some areas adjacent to stream channels, the upper

part of the surface layer is sandy loam, and strata of sand are in the lower part of the surface layer. In places, the surface layer is loam, and strata of loamy and sandy material are within a depth of 40 inches. In some places, clay loam glacial till is within a depth of 40 inches.

Included in mapping are small areas of the poorly drained Dovray and Playmoor soils. These soils make up less than 10 percent of any one mapped area. Dovray soils have more clay than this LaDelle soil, and they are in lower lying areas. Playmoor soils have salts and are in low wet areas.

Permeability is moderate. The available water capacity is high. Fertility is medium or high, and the content of organic matter is moderate or high. The shrink-swell potential is moderate. Runoff is slow. In some periods during the growing season, the water table is between depths of 4 and 6 feet.

In most areas, this soil is used for farming. In a few areas, it is in native grass and is used for grazing or hay. This soil has good potential for cultivated crops; for use as tame pasture, hayland, and rangeland; for windbreaks and environmental plantings; and for the development of habitat for openland wildlife. It has fair potential for the development of habitat for rangeland wildlife. This soil has poor potential for building site development and for most sanitary facilities.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for pasture and hay. If this soil is used for crops, maintaining fertility and tilth is the main concern of management. Minimum tillage, crop residue management, timely tillage, and the use of grasses and legumes in the cropping system help to maintain fertility and tilth. Planting and harvesting commonly are delayed in wet periods.

This soil is well suited to use as tame pasture or hayland. It is suited to all climatically adapted pasture plants. Stocking at the proper rate, rotating grazing, deferring grazing, and controlling brush and weeds help to keep tame pasture in good condition. Reseeding adapted grasses and legumes and applying fertilizer help to improve pasture that is in poor condition.

This soil is well suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs grow well if the competing vegetation is controlled. Good site preparation, cultivation, and herbicides help control competing vegetation.

This soil is poorly suited to building site development and sanitary facilities because of the hazards of wetness and flooding. Sites that are more suitable for buildings generally are available on the adjacent upland soils. To help prevent road damage resulting from frost action and the low strength of the soil, local roads should be constructed on raised and well compacted, better suited material obtained offsite.

Capability unit I-1; Overflow range site.

Lb—LaDelle silt loam, channeled. This is a deep, moderately well drained, nearly level soil on bottom lands and benches along intermittent streams and drainageways. This soil is frequently flooded. The areas are dissected by meandering channels that are 4 to 10 feet deep. The areas are long and narrow and range from 10 to 150 acres in size.

Typically, the surface layer is about 18 inches thick. It is dark gray silt loam about 6 inches thick in the upper part and dark gray, friable, calcareous silt loam about 12 inches thick in the lower part. The underlying material, to a depth of 60 inches, is gray, calcareous silty clay loam. In some areas, this soil is loam throughout. In places, strata of silt and clay and lenses of sand and gravel are in the underlying material. In places, the surface layer is loam, silty clay loam, or silty clay.

Included in mapping are small areas of Aastad, Forman, Marysland, Peever, Playmoor, Rauville, and Svea soils. These soils make up less than 15 percent of any one mapped area. The moderately well drained Aastad and Svea soils are not so stratified as this LaDelle soil. They are on foot slopes along drainageways. The well drained Forman and Peever soils are in isolated higher areas. Marysland, Playmoor, and Rauville soils are poorly drained or very poorly drained and are in the lower parts of drainageways.

Permeability is moderate. The available water capacity is high. Fertility is medium or high, and the content of organic matter is moderate or high. Runoff is slow. The seasonal water table is between depths of 4 and 6 feet.

In most areas, this soil is in native grass and is used for grazing or wildlife habitat. In some areas, it is in native trees and shrubs. This soil has good potential for use as rangeland, tame pasture, and hayland. It has poor potential for cultivated crops, for windbreaks and environmental plantings, and for the development of habitat for openland and rangeland wildlife. This soil has poor potential for building site development and for most sanitary facilities.

This soil is best suited to use as rangeland. The natural plant community is a mixture of tall and mid grasses. Overgrazing rangeland causes deterioration of the plant community; the taller, more productive grasses lose vigor and are replaced by less productive short grasses and undesirable plants. A planned grazing system that includes proper grazing use and deferred grazing helps to keep range in good condition.

In some areas, this LaDelle soil can be used for farming; however, these areas generally are too small for farming because they are dissected by a meandering stream channel.

This soil is not suitable for use as sites for windbreaks and environmental plantings if the trees and shrubs commonly are planted using machinery. It can be used for adapted trees and shrubs that are planted by hand and given special care.

This soil is poorly suited to building site development and sanitary facilities because of the hazards of wetness and flooding. Sites that are more suitable for buildings generally are available on the adjacent upland soils. To help prevent road damage resulting from frost action and the low strength of the soil, local roads should be constructed on raised and well compacted, better suited material obtained offsite. Culverts and ditches can provide drainage.

Capability unit VIw-1; Overflow range site.

Lc—Ludden silty clay. This is a deep, poorly drained, nearly level soil on low bottom lands. This soil is frequently flooded for brief periods. Some areas are dissected by shallow drainageways. The areas are irregular in shape and range from 8 to 75 acres in size.

Typically, the surface layer is dark gray, calcareous silty clay to a depth of 27 inches, and it is gray, calcareous silty clay to a depth of 38 inches. The underlying material, to a depth of 60 inches, is gray, calcareous silty clay. In places where soil material has recently been deposited on the surface of this soil by water, the upper part of the surface layer is noncalcareous loam or silt loam. In some areas, lime is at a depth of more than 20 inches.

Included in mapping are small areas of Playmoor and Parnell soils. These soils make up less than 10 percent of any one mapped area. Playmoor soils are in low areas and have visible salts throughout. Parnell soils are very poorly drained and are in depressions.

Permeability is slow. The available water capacity is moderate or high. Fertility is medium, and the organic matter content is moderate. The shrink-swell potential is high. Runoff is slow. In areas where drainage has not been provided, this soil is ponded after a heavy rain. This soil is difficult to farm, and tilth deteriorates if this soil is cultivated at a high moisture content. The water table is at the surface or within a depth of 2 feet early in the growing season.

In most areas, this soil is in native grass and is used for grazing or hay. In some areas, it is used for farming. In areas where this soil has been drained, this soil has good potential for cultivated crops; for windbreaks and environmental plantings; and for use as rangeland, tame pasture, and hayland. In undrained areas, it has fair potential for cultivated crops and for use as tame pasture and hayland. This soil has fair potential for the development of habitat for openland and rangeland wildlife. In undrained areas, this soil has good potential for the development of habitat for wetland wildlife.

This soil is suited to use as tame pasture and hayland. Overgrazing pasture causes deterioration of the plant community; the more desirable grasses lose vigor and are replaced by less productive grasses and other plants. Stocking at the proper rate, rotating pasture, applying fertilizer, deferring grazing, controlling weeds, and restricting use in wet periods help to keep pasture in good condition.

If this soil is used for cultivated crops, the main concerns of management are controlling wetness and soil blowing and maintaining the tilth and fertility of the soil. The excess lime in the surface layer restricts the availability of plant nutrients. Returning crop residue and adding other organic material to the soil help to improve tilth and fertility and to increase water infiltration. The use of minimum tillage and winter cover crops helps to prevent soil blowing. Controlling the runoff from adjacent soils and providing drainage for this soil help to reduce wetness.

This soil is suited to use as rangeland. The natural plant cover is mainly a mixture of tall grasses. Overgrazing rangeland causes deterioration of the plant community; the taller, more productive grasses are replaced by less productive grasses and weeds. A planned grazing system that includes proper grazing and deferred grazing helps to maintain or improve range condition.

If the excess water is removed, this soil is well suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs grow well because the moisture supply is good. Competing vegetation can be controlled through cultivation and the use of herbicides. Wetness is a limitation to planting trees.

This soil is poorly suited to building site development because of the hazard of flooding and the high water table. Sites that are more suitable for buildings generally are available on the adjacent upland soils. To help prevent road damage caused by frost action and by the shrinking and swelling of the soil, local roads should be constructed on raised and well compacted, better suited material obtained offsite. Ditches and culverts can provide drainage. This soil is poorly suited to most sanitary facilities because of the high water table and the hazard of flooding. It has few limitations for sewage lagoons.

Capability unit IIIw-2, drained, and IVw-2, undrained; Overflow range site.

MaE—Maddock loamy fine sand, 6 to 25 percent slopes. This is a deep, well drained, moderately sloping to moderately steep soil on convex ridgetops, knolls, and short side slopes. The areas generally are long and narrow and range from 4 to 65 acres in size.

Typically, the surface layer is about 14 inches thick. It is dark gray loamy fine sand about 7 inches thick in the upper part and dark gray loamy fine sand about 7 inches thick in the lower part. The subsoil is yellowish brown, loose loamy fine sand about 10 inches thick. The underlying material, to a depth of 60 inches, is yellowish brown and pale brown loamy fine sand. In places, the surface layer is thinner than is typical due to soil blowing. In some places, loam or clay loam glacial till is within a depth of 40 inches.

Included in mapping are small areas of Arvilla, Heimdal, and Sioux soils. These soils make up less than 15

percent of any one mapped area. Arvilla soils are on knolls and are underlain by sand and gravel. Heimdal soils are intermingled with this Maddock soil and have more clay. Sioux soils are on ridgetops in areas where there are pockets of gravel.

Permeability is rapid. The available water capacity is low or moderate. Fertility is medium or low, and the organic matter content is moderate or low. Runoff is slow.

In some areas, this soil is used for farming. In a few areas, it is in native grass and is used for grazing or hay. This soil has good potential for use as rangeland. It has fair potential for use as tame pasture and hayland, for windbreaks and environmental plantings, and for the development of habitat for rangeland wildlife. This soil has poor potential for cultivated crops and for the development of habitat for openland wildlife.

This soil is best suited to use as rangeland. The native vegetation is a mixture of tall and mid grasses. Controlling soil blowing is the main concern of management. Maintaining an adequate vegetative cover and ground mulch helps to prevent excessive soil loss. Overgrazing rangeland reduces the vegetative cover and causes deterioration of the plant community. The taller, more desirable grasses are replaced by less productive short grasses and weeds. A planned grazing system that includes proper grazing and deferred grazing helps to maintain or improve range condition.

This soil is poorly suited to cultivated crops because it is susceptible to soil blowing.

Using this soil as tame pasture or hayland is effective in controlling soil blowing. Overgrazing tame pasture reduces the vegetative cover and increases the hazard of soil blowing. Stocking at the proper rate, rotating grazing, and deferring grazing help to keep pasture in good condition and help to control soil blowing. A planned grazing system that includes proper grazing use and deferred grazing helps to maintain or improve the range condition of native pasture.

This soil is suited to use as sites for windbreaks and woody plants that commonly are planted using machinery. This soil is better suited to evergreens than to deciduous trees. Leaving the site fallow in summer is not recommended for this soil because of the hazard of soil blowing. Planting trees and shrubs in sod or in furrows helps to control soil blowing.

This soil is poorly suited to building site development and sanitary facilities because of slope. If roads are constructed on this soil, roadside erosion can be controlled by seeding adapted grasses in the borrow areas. Septic tank absorption fields function well in the less sloping areas of this soil; however, the pollution of ground water is a hazard.

Capability unit VIs-1; Sands range site.

Mb—Marysland loam. This is a poorly drained, nearly level soil on stream terraces and on flats on glacial outwash plains. This soil is subject to rare flooding in spring. It is moderately deep over sand and gravel. Sluggish drainageways are in some areas. The areas of this soil are long and narrow or irregular in shape and range from 4 to several hundred acres in size.

Typically, the surface layer is about 25 inches thick. It is dark gray, calcareous loam about 7 inches thick in the upper part and gray, very friable calcareous loam about 8 inches thick in the lower part. The underlying material, to a depth of 38 inches, is light gray, calcareous loam that has strata of gravelly loam. Light brownish gray, calcareous sand and gravel are at a depth of 38 inches. In places, the surface layer is silt loam.

Included in mapping are small areas of Divide and Rauville soils. These soils make up less than 10 percent of any one mapped area. The somewhat poorly drained Divide soils are adjacent to upland soils. The very poorly drained Rauville soils are in low wet areas.

Permeability is moderate in the upper part of the soil and rapid in the underlying sand and gravel. The available water capacity is moderate. The organic matter content is moderate or high, and fertility is medium. Runoff is slow. The water table is between depths of 1 and 4 feet during part of the growing season.

This soil has fair potential for crops, for use as tame pasture and hayland, and for the development of habitat for rangeland wildlife. It has good potential for use as rangeland, for windbreaks and environmental plantings, and for the development of habitat for wetland wildlife. If drained, this soil has good potential for crops and for use as tame pasture and hayland. It has poor potential for building site development and sanitary facilities.

This soil is well suited to use as rangeland. The natural plant community is a mixture of tall grasses. Overgrazing rangeland causes deterioration of the plant community; the taller, more desirable grasses are replaced by less productive grasses. A planned grazing system that includes proper grazing use and deferred grazing helps to maintain or improve the range condition of native pasture.

If this soil is used for farming, the main concerns of management are related to wetness and fertility. This soil is subject to flooding, and in most years, wetness resulting from the high water table delays farming operations. The high content of lime restricts the availability of plant nutrients. Unprotected areas are subject to soil blowing. Crop residue management, the use of green manure crops, applying fertilizer, and regularly adding other organic material to the soil help to improve fertility and maintain soil tilth. Using winter cover crops helps to control soil blowing.

This soil is suited to use as tame pasture or hayland. It is best suited to pasture plants that tolerate wetness. Overstocking tame pasture causes deterioration of the plant community; the more desirable grasses are replaced by less productive grasses and undesirable plants. Seeding adapted grasses and applying fertilizer

help to establish a good stand. Stocking at the proper rate, rotating grazing, and deferring grazing help to keep pasture in good condition.

This soil is well suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs grow well because the moisture supply is good; however, shallowness to the water table restricts root development. Competing vegetation can be controlled through good site preparation, cultivation, and the use of herbicides.

This soil is poorly suited to building site development and sanitary facilities because of the hazards of wetness and rare flooding. Sites that are more suitable for buildings generally are available on the adjacent upland soils. To help prevent road damage resulting from frost action and the low strength of the soil, local roads should be constructed on raised and well compacted, better suited material obtained offsite.

Capability unit IIw-3, drained, and IVw-2, undrained; Subirrigated range site.

Oa—Overly silty clay loam. This is a deep, moderately well drained, nearly level soil on high terraces and flats on uplands. The areas are irregular in shape and range from 8 to 98 acres in size.

Typically, the surface layer is about 12 inches thick. It is very dark gray silty clay loam about 7 inches thick in the upper part and dark gray silty clay loam about 5 inches thick in the lower part. The subsoil is friable silty clay loam about 11 inches thick. The upper part of the subsoil is grayish brown, and the lower part is light brownish gray and calcareous. The underlying material, to a depth of 42 inches, is light brownish gray and pale olive, calcareous silty clay loam. Below that, to a depth of 60 inches, it is pale yellow and light gray, calcareous, stratified silt loam, silty clay loam, and clay loam. In places, the underlying material has strata of sandy or clayey material within a depth of 40 inches. In some areas, the surface layer has more sand than is typical.

Included in mapping are small areas of the somewhat poorly drained Bearden soils and the well drained Peever soils. These soils make up less than 10 percent of any one mapped area. Bearden soils are in shallow swales and drainageways. Peever soils formed in glacial till and are on slight rises.

Permeability is moderately slow. The available water capacity is high. Fertility is medium or high, and the content of organic matter is moderate or high. The shrink-swell potential is moderate. Runoff is slow.

In most areas, this soil is used for farming. It has good potential for cultivated crops; for use as tame pasture, hayland, and rangeland; for windbreaks and environmental plantings; and for the development of habitat for openland and rangeland wildlife. This soil has fair potential for building site development and sanitary facilities.

This soil is well suited to corn, flax, and small grains. If this soil is used for crops, maintaining fertility and tilth is the main management concern. Minimum tillage, timely tillage, and the use of grasses and legumes in the cropping system help to maintain fertility and tilth and to increase water infiltration.

This soil is well suited to use as tame pasture and hayland. Stocking at the proper rate, rotating grazing, deferring grazing, controlling weeds, and restricting use of the pasture in wet periods help to keep pasture in good condition. Seeding adapted grasses and legumes and applying fertilizer help to increase production.

This soil is well suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs grow well if the competing vegetation is controlled. Good site preparation, cultivation, and the use of herbicides help in controlling competing vegetation. Leaving the site fallow for a year prior to planting helps to eliminate grasses and weeds and to conserve moisture.

If buildings are constructed on this soil, foundations and footings should be reinforced to help prevent structural damage caused by the shrinking and swelling of the soil. Local roads should be graded to shed water, and the base material should be compacted to help prevent road damage resulting from frost action and the low strength of the soil. Septic tank absorption fields on this soil need to be enlarged because liquid wastes are absorbed slowly. Sewage lagoons function well on this soil.

Capability unit I-1; Silty range site.

Pa—Parnell silty clay loam. This is a deep, very poorly drained, level soil in closed depressions. This soil is frequently flooded by runoff from adjacent soils (fig. 9). The areas are circular or oblong in shape and range from 2 to 15 acres in size.

Typically, the surface layer is very dark gray silty clay loam about 11 inches thick. The subsoil is firm silty clay about 43 inches thick. The upper part of the subsoil is very dark gray, the middle part is dark gray, and the lower part is gray. The underlying material, to a depth of 60 inches, is gray silty clay. In places, the surface layer is clay loam.

Included in mapping and making up less than 10 percent of any one mapped area are small areas of the poorly drained Vallers soils around depressions.

Permeability is slow. The available water capacity is moderate or high. The organic matter content and fertility are high. The shrink-swell potential is high. Runoff is very slow. The water table is at the surface or within a depth of 2 feet during much of the year.

In most areas, this soil is used as tame pasture and hayland. This soil has good potential for the development of habitat for wetland wildlife. It has fair potential for use as rangeland, tame pasture, and hayland and for the development of habitat for rangeland wildlife. This soil has poor potential for windbreaks and environmental plantings and for the development of habitat for openland wildlife. If this soil is drained, it has good potential

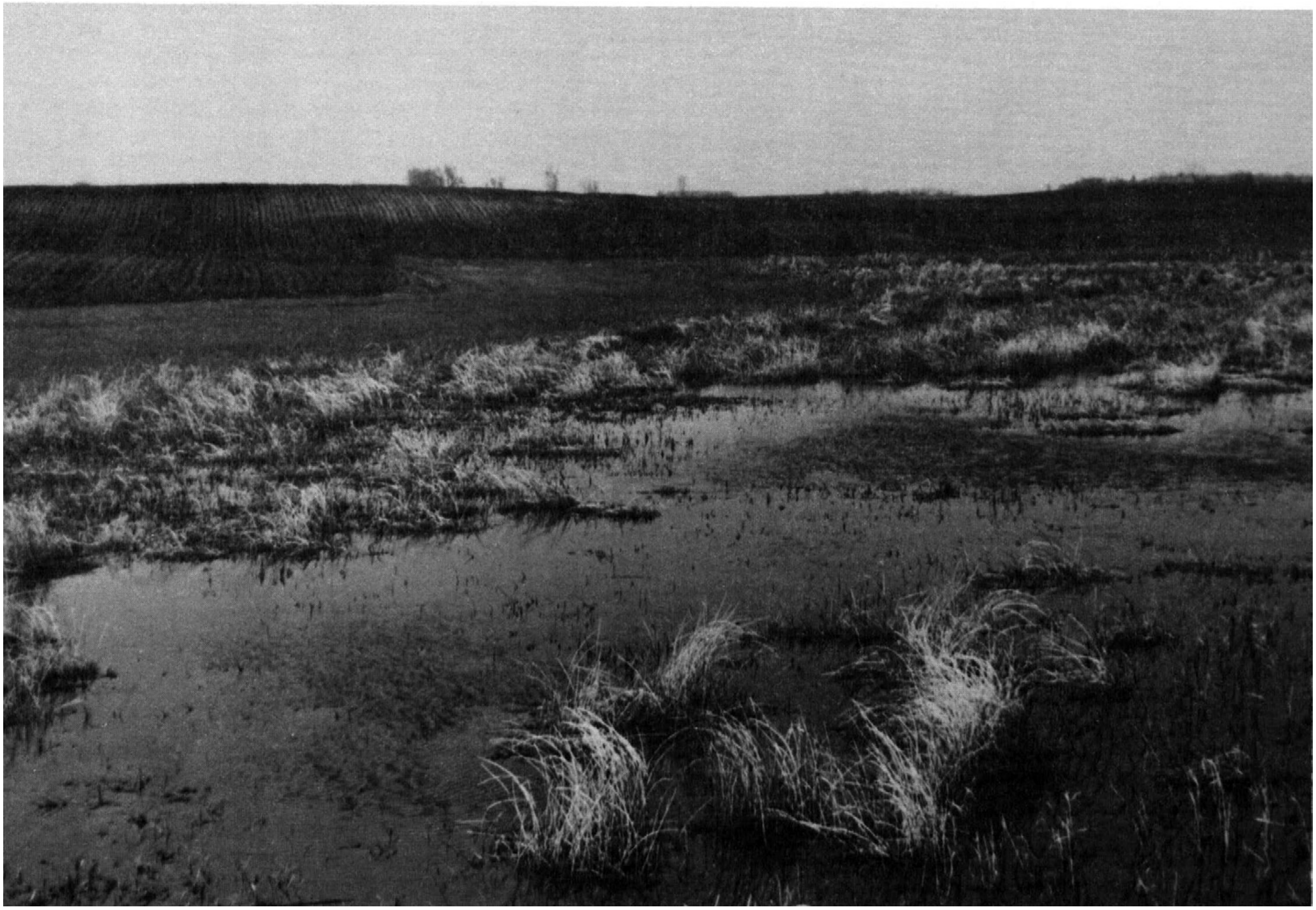


Figure 9.—This area of Parnell silty clay loam is frequently flooded.

for use as tame pasture and hayland and fair potential for cultivated crops. This soil has poor potential for building site development and for most sanitary facilities.

If this soil is adequately drained, it is suited to small grains and to grasses for pasture and hay. If this soil is used for crops, controlling wetness and maintaining tilth are the main management concerns. Controlling the runoff from adjacent soils and using open drains help to control wetness. Crop residue management and timely tillage help to maintain tilth.

If drainage can be provided, this soil is well suited to use as tame pasture and hayland. It is best suited to pasture plants that tolerate wetness. Controlling wetness is the main concern of management. Stocking at the proper rate, rotating grazing, and deferring grazing help to keep pasture in good condition.

This soil is poorly suited to building site development because of the hazards of flooding, wetness, and low strength. To help prevent road damage caused by flooding, wetness, and low strength, local roads should be constructed on raised and well compacted, better suited material obtained offsite. This soil has few limitations for sewage lagoons.

Capability unit IIIw-1, drained, and Vw-2, undrained; Wetland range site.

Pb—Parnell silty clay loam, ponded. This is a deep, very poorly drained, level soil in closed depressions on uplands. This soil is frequently flooded by runoff from adjacent soils, and water ponds on the surface during much of the year. The areas are circular or oblong in shape and range from 2 to 115 acres in size.

Typically, the surface layer is very dark gray silty clay loam about 11 inches thick. The subsoil is firm silty clay about 43 inches thick. The upper part of the subsoil is very dark gray, the middle part is dark gray, and the

lower part is gray. The underlying material, to a depth of 60 inches, is gray silty clay. In places, lime is in the surface layer.

Included in mapping and making up less than 10 percent of any one mapped area are small areas of the poorly drained Vallers soils. Vallers soils are in bands around depressions.

Permeability is slow. The available water capacity is moderate or high. Fertility and the content of organic matter are high. The water table is at the surface or within a depth of 1 foot during much of the year. This soil is ponded except during long droughty periods.

In most areas, this soil is used as habitat for wetland wildlife, for which it has good potential. It has poor potential for cultivated crops; for use as tame pasture, hayland, and rangeland; for windbreaks and environmental plantings; and for the development of habitat for openland wildlife. This soil has poor potential for building site development and for most sanitary facilities.

This soil is not suitable for farming or for use as tame pasture or rangeland. In most areas, the vegetation consists of rushes, cattails, and sedges. This soil is too wet and floods too frequently for building site development and septic tank absorption fields. Sewage lagoons can be constructed on this soil if the depth of flooding does not exceed 5 feet.

Capability unit VIIIw-1; not assigned to a range site.

PcA—Peever clay loam, 0 to 2 percent slopes. This is a deep, well drained, nearly level soil on uplands. The areas range from about 5 to several hundred acres in size.

Typically, the surface layer is dark gray clay loam about 9 inches thick. The subsoil is about 33 inches thick. The upper part of the subsoil is dark gray and dark grayish brown, firm clay; the middle part is grayish brown, firm, calcareous clay; the lower part is light brownish gray, firm, calcareous clay loam. The underlying material, to a depth of 60 inches, is light brownish gray, calcareous clay loam.

Included in mapping are small areas of Cavour, Forman, Rentill, Swenoda, and Tonka soils. These soils make up less than 15 percent of any one mapped area. Cavour soils have a claypan subsoil; they are intermingled with this Peever soil. Forman soils have less clay than this Peever soil and are on slight rises. Rentill and Swenoda soils have more sand and are intermingled with this Peever soil. The poorly drained Tonka soils are in shallow depressions.

Permeability is moderately slow or slow. The available water capacity is moderate or high. Fertility is medium or high, and the content of organic matter is moderate. The shrink-swell potential is high. Runoff is slow. The surface layer is friable, but tilth deteriorates if this soil is cultivated at a high moisture content.

In most areas, this soil is used for farming. In a few small areas, it is in native grass and is used for grazing or hay. This soil has good potential for cultivated crops; for use as tame pasture, hayland, and rangeland; and for the development of habitat for openland and rangeland wildlife. It has fair potential for windbreaks and environmental plantings. This soil has poor potential for building site development and sanitary facilities.

This soil is suited to corn, soybeans, sunflowers, small grains, and grasses and legumes for hay and pasture. If this soil is used for cultivated crops, maintaining tilth and fertility is the main concern of management. If this soil is cultivated when wet, the surface compacts, and plowpans form. The use of minimum tillage and winter cover crops helps to conserve moisture. The use of crop residue, green manure crops, and grasses and legumes in the cropping system and timely tillage help to improve fertility and tilth and to increase water infiltration.

Using this soil as tame pasture and hayland also is effective in maintaining tilth. This soil is suited to all climatically adapted pasture plants. Overgrazing tame pasture causes deterioration of the plant community; the more productive grasses lose vigor and are replaced by less productive grasses and other plants. Stocking at the proper rate, rotating grazing, controlling weeds, and applying fertilizer help to keep pasture in good condition.

This soil is suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs grow well if the competing vegetation is controlled. Good site preparation, cultivation, and the use of herbicides help in controlling competing vegetation. Leaving the site fallow for a year prior to planting helps to eliminate grasses and weeds and to conserve moisture.

If buildings are constructed on this soil, foundations and footings should be reinforced to help prevent structural damage caused by the shrinking and swelling of the soil. Local roads should be constructed on raised and well compacted material to help prevent road damage by shrinking and swelling. If this soil is used as septic tank absorption fields, the absorption area needs to be enlarged to help overcome the slow absorption of liquid waste. Sewage lagoons function well on this soil.

Capability unit IIs-2; Clayey range site.

PcB—Peever clay loam, 2 to 6 percent slopes. This is a deep, well drained, gently sloping and gently undulating soil on uplands. Some areas are dissected by shallow drainageways, and small wet depressions are common. In a few areas, stones are on the surface on the higher part of the landscape. The areas are irregular in shape and range from 3 to several hundred acres in size.

Typically, the surface layer is dark gray clay loam about 9 inches thick. The subsoil is about 33 inches thick. The upper part of the subsoil is dark gray and dark grayish brown, firm clay; the middle part is grayish brown, firm, calcareous clay; and the lower part is light brownish gray, firm calcareous clay loam. The underlying

material, to a depth of 60 inches, is light brownish gray, calcareous clay loam. In places, the subsoil is thicker than is typical, and lime is at a greater depth. On some knolls where material from the upper part of the subsoil has been mixed with the original surface layer by plowing, the present surface layer is grayish brown.

Included in mapping are small areas of Aastad, Cavour, Forman, Parnell, Rentill, Swenoda, and Tonka soils. These soils make up less than 15 percent of any one mapped area. The moderately well drained Aastad soils are in shallow swales. Cavour soils have a claypan subsoil and are intermingled with this Peever soil. Forman soils are on the top of some knolls and have less clay than this Peever soil. The very poorly drained Parnell soils and the poorly drained Tonka soils are in shallow depressions. Rentill and Swenoda soils are intermingled with this Peever soil and have more sand.

Permeability is moderately slow or slow. The available water capacity is moderate or high. Fertility is medium or high, and the organic matter content is moderate. The shrink-swell potential is high. Runoff is medium. The surface layer is friable, but tilth deteriorates if this soil is cultivated at a high moisture content.

In most areas, this soil is used for farming. It has good potential for use as tame pasture, hayland, and rangeland and for the development of habitat for rangeland wildlife. This soil has fair potential for cultivated crops, for windbreaks and environmental plantings, and for the development of habitat for openland wildlife. It has poor potential for building site development and sanitary facilities.

This soil is suited to corn, soybeans, sunflowers, small grains, and grasses and legumes for hay and pasture. If this soil is used for crops, controlling erosion and maintaining tilth are the main concerns of management. If this soil is cultivated when wet, the surface compacts, and plowpans form. Minimum tillage, contour stripcropping, terracing, and the use of winter cover crops help to prevent erosion and conserve moisture. Returning crop residue to the soil and including grasses and legumes in the cropping system help to improve fertility and tilth and to increase water infiltration.

Using this soil as pasture and hayland also is effective in controlling erosion. This soil is suited to all climatically adapted pasture plants. Overgrazing tame pasture reduces the vegetative cover and causes deterioration of the plant community. The more desirable grasses are replaced by less productive grasses and undesirable plants. Seeding adapted grasses and applying fertilizer help to establish a good vegetative cover and help to control runoff and erosion. Stocking at the proper rate, rotating grazing, and controlling weeds help to keep pasture in good condition.

This soil is suited to windbreaks and environmental plantings. All climatically adapted trees and shrubs grow well if the competing vegetation is controlled. Good site preparation, cultivation, and the use of herbicides help in controlling competing vegetation. Leaving the site fallow for a year prior to planting helps to eliminate grasses and weeds and to conserve moisture.

If buildings are constructed on this soil, foundations and footings should be reinforced to help prevent structural damage caused by the shrinking and swelling of the soil. Local roads should be constructed on raised and well compacted material to help prevent road damage caused by shrinking and swelling. If this soil is used as a site for septic tank absorption fields, the absorption area needs to be enlarged to help overcome the slow absorption of the liquid waste. If this soil is used as a site for sewage lagoons, the surface needs to be leveled in some areas.

Capability unit IIIe-3; Clayey range site.

PcC—Peever clay loam, 6 to 9 percent slopes. This is a deep, well drained, moderately sloping soil on convex knolls, ridges, and short side slopes. Some areas are dissected by shallow drainageways, and, in places, stones of variable amount and size are scattered on the surface. The areas range from 3 to more than 100 acres in size.

Typically, the surface layer is dark gray clay loam about 9 inches thick. The subsoil is about 33 inches thick. In the upper part, it is dark gray and dark grayish brown, firm clay; in the middle part, it is grayish brown, firm, calcareous clay; and in the lower part, it is light brownish gray, firm, calcareous clay loam. The underlying material, to a depth of 60 inches, is light brownish gray, calcareous clay loam. In places, the subsoil is thinner than is typical, and lime is at a lesser depth. On knolls and ridgetops where the original surface layer has been mixed with the subsoil by plowing, the present surface layer is grayish brown.

Included in mapping are small areas of the moderately well drained Aastad soils in swales and shallow drainageways and the well drained Hattie soils on ridges and knolls. These soils make up less than 15 percent of any one mapped area.

Permeability is moderately slow or slow. The available water capacity is moderate or high. Fertility is medium or high, and the organic matter content is moderate. The shrink-swell potential is high. Runoff is medium. The surface layer is friable, but tilth deteriorates if this soil is cultivated at a high moisture content.

In most areas, this soil is used for farming. In a few areas, it is in native grass and is used for grazing or hay. This soil has good potential for use as tame pasture, hayland, or rangeland and for the development of habitat for rangeland wildlife. It has fair potential for cultivated crops, for windbreaks and environmental plantings, and for the development of habitat for openland wildlife. This soil has poor potential for building site development and sanitary facilities.

This soil is suited to corn, sunflowers, small grains, and grasses and legumes for pasture and hay. If this soil

is used for crops, controlling erosion and maintaining tilth and fertility are the main concerns of management. If this soil is cultivated when wet, the surface compacts and plowpans form. Minimum tillage, contour stripcropping, terraces, and close-growing crops help to control erosion and to conserve moisture. Returning crop residue to the soil, using grasses and legumes in the cropping system, and timely farming operations help to maintain tilth and fertility and to increase water infiltration.

Using this soil as pasture or hayland also is effective in controlling erosion. This soil is suited to all climatically adapted pasture plants. Overgrazing tame pasture reduces the vegetative cover and causes deterioration of the plant community. The taller, more productive grasses lose vigor and are replaced by less productive grasses and undesirable plants. Seeding adapted grasses and using fertilizer can help to establish a good vegetative cover. Proper stocking rates, rotation grazing, weed control, and timely deferment of grazing help to keep pasture and soil in good condition.

This soil is suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs grow well if the competing vegetation is controlled. Good site preparation, cultivation, and the use of herbicides help to control competing grasses and weeds. Leaving the site fallow for a year prior to planting helps to eliminate grasses and weeds and to conserve moisture. Planting trees on the contour helps to conserve moisture and control erosion.

If buildings are constructed on this soil, foundations and footings should be reinforced to help prevent structural damage caused by the shrinking and swelling of the soil. Local roads should be constructed on raised and well compacted material to help prevent damage to the road caused by shrinking and swelling. Seeding adapted grasses in borrow areas helps to control roadside erosion and to prevent gully erosion. If this soil is used as a site for septic tank absorption fields, the absorption area should be enlarged to help overcome the slow absorption of liquid waste. Land leveling is needed if this soil is used for sewage lagoons.

Capability unit IIIe-4; Clayey range site.

Pd—Peever-Cavour complex. This complex consists of deep, well drained and moderately well drained, nearly level soils on uplands. Slopes are 0 to 3 percent. The areas of this map unit range from 4 to several hundred acres in size. They are 60 to 70 percent Peever soils and 20 to 30 percent Cavour soils. The well drained Peever soil is on plane to slightly convex rises. The moderately well drained Cavour soil is in the lower positions on the landscape where the surface is slightly concave. In cultivated fields, the Cavour soil is in irregularly shaped, gray colored areas that are surrounded by the Peever soil. These soils are so intermingled or the areas of each soil are so small that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Peever soil is dark gray clay loam about 9 inches thick. The subsoil is about 33 inches thick. The upper part of the subsoil is dark gray and dark grayish brown, firm clay; the middle part is grayish brown, firm, calcareous clay; and the lower part is light brownish gray, firm, calcareous clay loam. The underlying material, to a depth of 60 inches, is light brownish gray, calcareous clay loam. In places, the surface layer and subsoil are thinner than is typical, and lime is at a lesser depth.

Typically, the surface layer of the Cavour soil is dark gray loam about 6 inches thick. The subsurface layer is gray silt loam about 2 inches thick. The subsoil is about 19 inches thick. The upper part of the subsoil is dark gray, very firm clay; the middle part is grayish brown, firm clay; and the lower part is grayish brown, firm, calcareous clay that has spots and nests of salt. The underlying material, to a depth of 60 inches, is light brownish gray, calcareous clay loam.

Included in mapping are small areas of Forman, Swenoda, and Tonka soils. These soils make up less than 10 percent of any one mapped area. Forman soils have less clay and are on slight rises. Swenoda soils are in slight swales and have more sand in the upper part than Peever and Cavour soils. The poorly drained Tonka soils are in shallow depressions.

Permeability in the Peever soil is moderately slow or slow, and in the Cavour soil it is slow or very slow. Fertility in the Peever soil is medium or high, and in the Cavour soil it is low or medium. The available water capacity in the Peever and Cavour soils is moderate or high. The shrink-swell potential is high. Runoff is slow. The subsoil of the Cavour soil is very firm and restricts the development of plant roots. The Cavour soil has a layer of salt concentration between depths of 16 and 27 inches.

In most areas, these soils are used for farming. In a few areas, they are in native grass and are used for grazing or hay. The Peever soil has good potential for cultivated crops; for use as tame pasture, hayland, and rangeland; and for the development of habitat for openland and rangeland wildlife. It has fair potential for windbreaks and environmental plantings. The Cavour soil has fair potential for cultivated crops and for use as tame pasture, hayland, and rangeland. It has poor potential for windbreaks and environmental plantings and for the development of habitat for openland and rangeland wildlife. These soils have poor potential for building site development and sanitary facilities.

The Peever soil is suited to corn, sunflowers, small grains, and grasses and legumes for pasture and hay. The Cavour soil is better suited to small grains and grasses and legumes for pasture and hay than to row crops. If these soils are used for crops, maintaining tilth is the main concern of management. Crop residue management, the use of legumes in the cropping system,

chiseling, and timely tillage help to maintain or improve tilth and the water intake rate.

The soils in this unit are suited to use as pasture or hayland. Grasses should be selected that tolerate the salty condition and dense subsoil of the Cavour soil in this unit. Overgrazing tame pasture causes deterioration of the plant community; the more desirable grasses lose vigor and are replaced by less productive grasses and other plants. Stocking at the proper rate, rotating grazing, controlling weeds, and applying fertilizer help to keep pasture in good condition.

The Peever soil is suited to windbreaks and environmental plantings. The Cavour soil is not suited to many trees and shrubs because it has a claypan subsoil that restricts root development and has sodium and other salts in the subsoil and underlying material. Most climatically adapted trees and shrubs grow well on the Peever soil. Good site preparation, cultivation, and the use of herbicides help in controlling competing vegetation. Leaving the site fallow for a year prior to planting helps to eliminate grasses and weeds and to conserve moisture.

If buildings are constructed on these soils, foundations and footings should be reinforced to help prevent structural damage caused by the shrinking and swelling of the soil. Local roads should be constructed on raised and well compacted material to help prevent road damage caused by shrinking and swelling. If these soils are used for septic tank absorption fields, the absorption area needs to be enlarged to help overcome the slow absorption of liquid waste. Sewage lagoons function well on these soils.

The Peever soil is in capability unit IIs-2, Clayey range site; the Cavour soil is in capability unit IVs-3, Claypan range site.

Pe—Peever-Tonka complex. This complex consists of deep, well drained and poorly drained, nearly level soils on uplands. The Tonka soil is subject to common flooding of long duration. The areas of this map unit range from 4 to more than 100 acres in size. They are 60 to 70 percent Peever soil and 25 to 35 percent Tonka soil. The Peever soil is in the higher, well drained areas. The Tonka soil is in shallow depressions. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Peever soil is dark gray clay loam about 9 inches thick. The subsoil is about 33 inches thick. The upper part of the subsoil is dark gray and dark grayish brown, firm clay; the middle part is grayish brown, firm, calcareous clay; and the lower part is light brownish gray, firm, calcareous clay loam. The underlying material, to a depth of 60 inches, is light brownish gray, calcareous clay loam. In places, the surface layer and subsoil are thinner than is typical, and lime is at a lesser depth.

Typically, the surface layer of the Tonka soil is dark gray silt loam about 10 inches thick. The subsurface layer is gray silt loam about 13 inches thick. The subsoil is about 27 inches thick. The upper part of the subsoil is dark gray, firm silty clay; the middle part is gray and olive gray, firm silty clay; and the lower part is gray, friable clay loam. The underlying material, to a depth of 60 inches, is light olive gray, mottled clay loam. In places where material from the subsurface layer has been mixed with the original surface layer by plowing, the present surface layer is light gray.

Included in mapping are small areas of Cavour, Forman, and Vallers soils. These soils make up less than 10 percent of any one mapped area. Cavour soils are intermingled with the Peever soil and have a claypan subsoil. Forman soils are on slight rises and have less clay than Peever and Tonka soils. Vallers soils are calcareous and are on rims surrounding the Tonka soil.

Permeability in the Peever soil is moderately slow or slow, and in the Tonka soil it is slow. The available water capacity in the Peever soil is moderate or high, and in the Tonka soil it is high. The organic matter content in the Peever soil is moderate, and in the Tonka soil it is high. Runoff on the Peever soil is slow, and on the Tonka soil it is ponded. Fertility in the Peever and Tonka soils is medium or high. The shrink-swell potential is high. The Tonka soil has a water table between depths of 3 and 5 feet during part of the growing season.

In most areas, these soils are used for farming. In a few areas, they are in native grass and are used for grazing or hay. The Peever soil has good potential for cultivated crops; for use as tame pasture, hayland, and rangeland; and for the development of habitat for openland and rangeland wildlife. It has fair potential for windbreaks and environmental plantings. If the Tonka soil is drained, it has good potential for cultivated crops and for use as tame pasture and hayland. If it has not been drained, it has fair potential for these uses. The Tonka soil has fair potential for use as rangeland and for the development of habitat for rangeland wildlife. It has poor potential for windbreaks and environmental plantings and for the development of habitat for openland wildlife. These soils have poor potential for building site development and sanitary facilities.

These soils are suited to corn, small grains, and grasses and legumes for pasture and hay; however, in wet years, crops on the Tonka soil are flooded. The main concerns of management are controlling wetness and maintaining tilth. In wet years, farming operations on the Tonka soil are delayed because runoff is ponded. Crop residue management, the use of green manure crops, and timely tillage help to maintain fertility and tilth. If drainage is feasible on the Tonka soil, controlling runoff from the adjacent soils and using diversions and open drains help to control wetness.

These soils are suited to use as pasture and hayland. Overgrazing tame pasture causes deterioration of the

plant community; the more desirable grasses lose vigor and are replaced by less productive grasses. For maximum crop production, water-tolerant grasses and legumes should be seeded in the drained and undrained areas of the Tonka soil. Stocking at the proper rate, rotating grazing, controlling weeds, deferring grazing, and restricting use of the pasture in wet periods help to keep pasture in good condition. A planned grazing system that includes proper grazing and deferred grazing helps to maintain or improve the condition of rangeland.

Windbreak and environmental plantings can be grown on these soils; however, growth is severely restricted on the Tonka soil. All climatically adapted trees and shrubs grow well on the Peever soil if the competing vegetation is controlled. Good site preparation, cultivation, and the use of herbicides help in controlling competing weeds and grasses.

If buildings are constructed on the Peever soil, foundations and footings should be reinforced to help prevent structural damage resulting from the shrinking and swelling of the soil. The Tonka soil generally is not suitable for building site development because of the hazards of wetness and flooding. To help prevent road damage by frost action and shrinking and swelling in areas of the Peever soil, local roads should be constructed on raised and well compacted material. In areas of the Tonka soil, to help prevent road damage that results from flooding and the low strength of the soil, local roads should be constructed on raised and compacted, better suited material obtained offsite. If the Peever soil is used as a site for septic tank absorption fields, the absorption area needs to be larger than typical because liquid wastes are absorbed slowly on that soil. Septic tank absorption fields should not be constructed on the Tonka soil because of the hazards of wetness and flooding. Sewage lagoons function well on these soils.

The Peever soil is in capability unit IIs-2, Clayey range site; the Tonka soil is in capability unit IIw-1, drained, and IVw-2, undrained, Wetland range site.

Pf—Pits, gravel. This map unit consists of open excavations, 5 to 30 feet deep, from which overburden sand and gravel have been removed. The areas of this unit are irregular in shape and range from 2 to 50 acres in size. Slopes are uneven and broken; they range from nearly level at the bottom of the pit to nearly vertical at the rim. In some pits, the bottom is covered with water.

The bottom of pits typically is sand and gravel, but in some pits the sand and gravel have been removed and loam or clay loam glacial till or silty glacial drift is exposed. Mounds of overburden consisting of loamy soil material are on the edge of the pits. The bottom and sides of the pits support little or no vegetation. Annual weeds grow on the mounds of overburden.

Most gravel pits are used only as a source of sand and gravel for use in construction. Some pits provide limited habitat for wildlife. If reclamation measures are used, abandoned gravel pits can be restored and used as range or tame pasture or for crops. Reclamation measures include shaping the areas and using the mounds of overburden material as topsoil. Applying fertilizer as needed helps in establishing range or pasture.

Capability unit VIIIs-1; not assigned to a range site.

Ph—Playmoor silty clay loam. This is a deep, nearly level, poorly drained soil on flat bottom lands. This soil is subject to flooding of brief duration in spring and after a heavy rain. Some areas are dissected by drainageways and major streams. The areas are irregular in shape and range from 5 to 170 acres in size.

Typically, the surface layer is about 36 inches thick. It is very dark gray, calcareous silty clay loam in the upper 8 inches; dark gray, friable, calcareous silty clay loam in the next 10 inches; and gray, friable, calcareous silty clay loam in the lower 18 inches. The underlying material, to a depth of 60 inches, is gray, calcareous silty clay loam. Salts have accumulated throughout the soil. In places, strata of sand and clay are within a depth of 40 inches. In some places, salts are at a greater depth than is typical.

Included in mapping are small areas of LaDelle, Ludden, and Vallers soils. These soils make up less than 15 percent of any one mapped area. The moderately well drained LaDelle soils are in higher positions on the landscape. Ludden soils have more clay than this Playmoor soil and are on low flats. Vallers soils formed in glacial till and are along the boundary of the mapped areas.

Permeability is moderately slow. The available water capacity is high. Fertility is medium, and the content of organic matter is high. Tilth deteriorates if this soil is worked at a high moisture content. Runoff is very slow. The water table is between depths of 0.5 foot and 3.5 feet during part of the growing season.

In most areas, this soil is used as pasture or for hay. In a few areas, it is used for farming. This soil has fair potential for crops, for use as tame pasture and hayland, and for the development of habitat for rangeland and wetland wildlife. It has good potential for use as rangeland. This soil has poor potential for windbreaks and environmental plantings and for the development of habitat for openland wildlife. It has poor potential for building site development and sanitary facilities.

This soil is suited to cultivated crops or to legumes for hay and pasture; however, in most years, wetness delays planting and tilling in spring. The main concerns of management are related to wetness and salinity. In cultivated areas, this soil is susceptible to soil blowing. Returning crop residue to the soil and using green manure crops and timely tillage help to maintain fertility and tilth. In areas where drainage is feasible, open drains can be used to remove excess water.

This soil is well suited to use as rangeland. The natural plant cover is a mixture of tall grasses. Overgrazing

rangeland causes deterioration of the plant community; the taller, more productive grasses are replaced by less productive grasses. Proper grazing use and deferred grazing help to maintain or improve the range condition of native pasture.

If this soil is used as tame pasture and hayland, salt- and water-tolerant pasture plants should be selected. Stocking at the proper rate, rotating grazing, controlling weeds, applying fertilizer, and deferring grazing help to keep pasture in good condition.

This soil generally is not suitable for windbreaks and environmental plantings if the trees and shrubs are planted using machinery. It can be used for adapted trees and shrubs that are hand planted and given special care.

This soil is poorly suited to building site development because of wetness and the hazard of flooding. To help prevent road damage resulting from flooding and the low strength of the soil, local roads should be constructed on raised and well compacted, better suited material obtained offsite. This soil is poorly suited to sanitary facilities because of the hazards of wetness and flooding.

Capability unit IVw-2; Saline Lowland range site.

Po—Poinsett silt loam. This is a deep, well drained, nearly level soil on smooth uplands. The areas are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is dark gray silt loam about 8 inches thick. The subsoil is friable silt loam about 11 inches thick. It is gray in the upper part and grayish brown in the lower part. The underlying material, to a depth of 50 inches, is light gray and light yellowish brown, calcareous silt loam. Below that, to a depth of 60 inches, it is light yellowish brown, calcareous loam. In places, loam or clay loam glacial till is within a depth of 40 inches.

Included in mapping and making up less than 10 percent of any one mapped area are small areas of Svea soils. The moderately well drained Svea soils are in shallow swales.

Permeability is moderate. The available water capacity is high. Fertility is medium or high, and the content of organic matter is moderate or high. Runoff is slow.

In most areas, this soil is used for farming. It has good potential for cultivated crops; for use as tame pasture, hayland, and rangeland; for windbreaks and environmental plantings; and for the development of habitat for openland and rangeland wildlife. It has fair potential for building site development and sanitary facilities.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. If this soil is used for crops, maintaining fertility is the main concern of management. Minimum tillage, stubble mulching, and returning crop residue to the soil help to maintain fertility.

This soil is well suited to use as tame pasture and hayland. Overgrazing causes deterioration of the plant community; the more desirable grasses lose vigor and are replaced by less productive grasses and weeds. Stocking at the proper rate, rotating grazing, applying fertilizer, and controlling weeds help to keep pasture in good condition.

This soil is well suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs grow well if the competing vegetation is controlled. Good site preparation, cultivation, and the use of herbicides help in controlling competing vegetation.

If buildings are constructed on this soil, foundations and footings should be reinforced to help prevent structural damage resulting from the shrinking and swelling and low strength of the soil. If this soil is used as a site for local roads and streets, the base material should be strengthened to help prevent road damage resulting from frost action and the low strength of the soil. If this soil is used as a site for septic tank absorption fields, the absorption area needs to be enlarged to help overcome the slow absorption of liquid waste. If sewage lagoons are constructed on this soil, seepage of effluent is a hazard. Seepage from sewage lagoons can be reduced by sealing the bottom and sides of the lagoon.

Capability unit I-2; Silty range site.

Ra—Rauville silty clay loam. This is a deep, very poorly drained, nearly level soil on low bottom lands, along drainageways, and in seepy spring areas. This soil is frequently flooded in spring and in wet periods. In many areas, small mounds of soil material 1 to 2 feet high are on the surface of this soil. The areas of this map unit are irregular in shape and range from 5 to 115 acres in size.

Typically, the surface layer is about 27 inches thick. It is gray and dark gray, calcareous silty clay loam about 7 inches thick in the upper part and dark gray, friable, calcareous silty clay loam about 20 inches thick in the lower part. The underlying material, to a depth of 45 inches, is light gray, calcareous silty clay loam. Below that, to a depth of 60 inches, it is light yellowish brown stratified gravel, sand, and clay loam. In places, the sand and gravel are within a depth of 40 inches.

Included in mapping are small areas of the poorly drained Marysland and Vallers soils. These soils make up less than 10 percent of any one mapped area. Marysland soils are on slight rises. Vallers soils formed in glacial till and are along the boundary of the mapped areas.

Permeability is moderate or moderately slow above the sand and gravel and moderately rapid in the sand and gravel. The available water capacity is high. Fertility and the organic matter content are high. Runoff is very slow. The water table is at the surface or within a depth of 2 feet most of the year.

This soil is used as rangeland and wildlife habitat. It has poor potential for cultivated crops, for the development of habitat for openland wildlife, and for windbreaks and environmental plantings. It has fair potential for use

as rangeland, pasture, and hayland and for the development of habitat for rangeland and wetland wildlife. This soil has poor potential for building site development and sanitary facilities.

This soil is best suited to use as rangeland or wildlife habitat. In most areas, this soil can be grazed only in the driest part of the year. Wetness in these areas limits the grasses that can be grown.

This soil generally is not suitable for crops or for windbreaks and environmental plantings.

This soil generally is not suited to building site development and sanitary facilities because of wetness and the hazard of flooding. To help prevent road damage that results from flooding and the low strength of the soil, roads should be constructed on raised and well compacted, better suited material obtained offsite.

Capability unit Vw-1; Wetland range site.

RbA—Renshaw loam, 0 to 2 percent slopes. This is a nearly level, somewhat excessively drained soil on stream terraces and on smooth uplands. The areas are irregular in shape and range from 5 to 135 acres in size.

Typically, the surface layer is dark gray loam about 6 inches thick. The subsoil is about 12 inches thick. The upper part of the subsoil is dark gray, very friable loam, and the lower part is brown and grayish brown, very friable loam. The underlying material, to a depth of 60 inches, is grayish brown and brown, calcareous sand and gravel.

Included in mapping are small areas of Divide, Fordville, Rentill, and Sioux soils. These soils make up less than 10 percent of any one mapped area. Divide soils are in low wet areas. Fordville soils are moderately deep over sand and gravel and are intermingled with this Renshaw soil. Rentill soils formed in loamy material overlying glacial till; they are on slight rises. Sioux soils are more shallow to sand and gravel than this Renshaw soil; they are on slight rises.

Permeability is moderately rapid in the surface layer and subsoil and rapid in the underlying sand and gravel. The available water capacity is low. Fertility is medium or low, and the organic matter content is moderate. Runoff is slow.

In most areas, this soil is used for farming. In a few areas, it is in native grass and is used for grazing or hay. This soil has fair potential for cultivated crops, for use as tame pasture and hayland, and for the development of habitat for openland wildlife. It has poor potential for use as rangeland, for windbreaks and environmental plantings, and for the development of habitat for rangeland wildlife. This soil has good potential for building site development and poor potential for most sanitary facilities.

This soil is suited to small grains and to grasses and legumes for pasture and hay. It is best suited to early-maturing crops because it has low available water capacity. If this soil is used for crops, conserving moisture is the main concern of management. Stripcropping, minimum tillage, and returning crop residue to the soil help to conserve moisture. Using grasses and legumes in the cropping system also helps to conserve moisture.

Using the soil as tame pasture or hayland also is effective in conserving moisture. The shallow root zone and low available water capacity of this soil limit the choice of pasture plants that can be grown. Stocking at the proper rate, rotating grazing, controlling weeds, and deferring grazing help to keep pasture in good condition. Reseeding adapted grasses and applying fertilizer help to increase production.

This soil is poorly suited to use as sites for windbreaks and environmental plantings. Because of the low available water capacity, survival and growth rates are poor. Selected trees and shrubs can be planted if they are given special care. Competing vegetation can be controlled through good site preparation, cultivation, and the use of herbicides.

This soil is well suited to building site development; however, the caving or sloughing of walls in shallow excavations is a hazard. This soil has few limitations to use as sites for local roads and streets. Septic tank absorption fields function well on this soil; however, the pollution of ground water is a hazard. This soil is not suited to use as sites for sewage lagoons because of the hazard of seepage in the underlying sand and gravel.

Capability unit IIIs-3; Shallow to Gravel range site.

RbB—Renshaw loam, 2 to 6 percent slopes. This is a gently sloping and gently undulating, somewhat excessively drained soil on convex ridgetops, knolls, and short, uneven side slopes. The areas are irregular in shape and range from 5 to 30 acres in size.

Typically, the surface layer is dark gray loam about 6 inches thick. The subsoil is about 12 inches thick. The upper part of the subsoil is dark gray, very friable loam, and the lower part is brown and grayish brown, very friable loam. The underlying material, to a depth of 60 inches, is grayish brown and brown, calcareous sand and gravel In some places, the surface layer is grayish brown. In other places, the subsoil has more sand than is typical.

Included in mapping are small areas of Divide, Fordville, and Sioux soils. These soils make up less than 15 percent of any one mapped area. Divide soils are moderately well drained or somewhat poorly drained and are in low swales. Fordville soils are deeper to sand and gravel than this Renshaw soil; they are on foot slopes and in swales. Sioux soils are on gravelly ridgetops.

Permeability is moderately rapid in the surface layer and subsoil and rapid in the underlying sand and gravel. The available water capacity is low. Fertility is medium or low, and the content of organic matter is moderate. Runoff is medium.

In most areas, this soil is used for farming. In a few areas, it is in native grass and is used for grazing or hay.

This soil has fair potential for cultivated crops and for use as tame pasture and hayland. It has poor potential for use as rangeland, for windbreaks and environmental plantings, and for the development of habitat for openland and rangeland wildlife. This soil has good potential for building site development and poor potential for most sanitary facilities.

This soil is suited to small grains and to grasses and legumes for pasture and hay. It is best suited to early-maturing crops because it has low available water capacity. If this soil is used for crops, conserving moisture is the main concern of management. Minimum tillage and returning crop residue to the soil help to conserve moisture. Using grasses and legumes and green manure crops in the cropping system help to maintain fertility and conserve moisture.

Using this soil as pasture or hayland also is effective in conserving moisture and maintaining fertility. Maintaining an adequate vegetative cover helps to improve the moisture supply by reducing runoff. Stocking at the proper rate, rotating grazing, controlling weeds, and deferring grazing help to keep pasture in good condition. Seeding adapted grasses and applying fertilizer help to improve production.

This soil is poorly suited to use as sites for windbreaks and environmental plantings. Because this soil is droughty due to the low available water capacity, survival and growth rates of trees and shrubs are poor. Selected trees and shrubs can be planted if they are given special care. Competing vegetation can be controlled through good site preparation, cultivation, and the use of herbicides.

This soil is well suited to building site development; however, the caving or sloughing of walls in shallow excavations is a hazard. This soil has few limitations to use as sites for local roads and streets. Septic tank absorption fields function well on this soil; however, the pollution of ground water is a hazard. This soil is not suited to use as sites for sewage lagoons because of the hazard of seepage in the underlying sand and gravel.

Capability unit IVs-2; Shallow to Gravel range site.

RcD—Renshaw-Sioux complex, 6 to 15 percent slopes. These are moderately sloping or rolling, somewhat excessively drained and excessively drained soils on upland ridges and side slopes. These soils are moderately shallow and shallow over sand and gravel. In some areas, stones are scattered on the surface. The areas of this map unit are irregular in shape and range from 5 to 60 acres in size. They are 50 to 60 percent Renshaw soil and 30 to 40 percent Sioux soil. The Renshaw soil is on the middle and lower parts of plane and convex side slopes and on the broader ridgetops. The Sioux soil is on the steeper ridgetops and on sharp breaks. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Renshaw soil is dark gray loam about 6 inches thick. The subsoil is about 12 inches thick. The upper part of the subsoil is dark gray, very friable loam, and the lower part is brown and grayish brown, very friable loam. The underlying material, to a depth of 60 inches, is grayish brown and dark brown, calcareous sand and gravel. In places, the subsoil has more sand than is typical.

Typically, the surface layer of the Sioux soil is very dark gray sandy loam about 6 inches thick. The next layer is dark grayish brown gravelly sandy loam about 6 inches thick. The underlying material, to a depth of 60 inches, is pale brown, calcareous sand and gravel. In places, the surface layer is thinner than is typical or has been removed through erosion.

Included in mapping and making up less than 10 percent of any one mapped area are areas of Fordville soils. Fordville soils are deeper to sand and gravel than Renshaw and Sioux soils and are on foot slopes and in broader swales.

Permeability in the Renshaw soil is moderately rapid in the upper part and rapid in the lower part. Permeability in the Sioux soil is rapid. The available water capacity in the Renshaw soil is low, and in the Sioux soil it is very low. The organic matter content in the Renshaw soil is moderate, and in the Sioux soil it is low. Runoff on these soils is medium.

In most areas, these soils are in native grass and are used for grazing and hay. These soils have poor potential for crops, for use as rangeland, for windbreaks and environmental plantings, and for the development of habitat for openland and rangeland wildlife. The Renshaw soil has fair potential for use as tame pasture and hayland, and the Sioux soil has poor potential. These soils have fair potential for building site development and poor potential for most sanitary facilities.

The soils in this unit are best suited to use as rangeland. The natural plant community is a mixture of middle and short grasses. These soils are droughty due to the low available water capacity. Maintaining an adequate vegetative cover and ground mulch helps to reduce runoff, thus preventing excessive soil loss and improving the moisture supply. Overgrazing rangeland causes deterioration of the plant community; the more desirable grasses are replaced by less productive short grasses. A planned grazing system that includes proper grazing use and deferred grazing helps to maintain or improve range condition.

These soils generally are not suitable for crops or for windbreaks and environmental plantings because of the steep slopes, low available water capacity, and shallowness to gravel.

If these soils are used for building site development, the surface generally needs to be shaped. The caving or sloughing of walls in shallow excavations is a hazard. In some steeper areas, excessive cuts are needed when grading for roads. Revegetating the back slopes is diffi-

cult because of the gravelly material that is exposed through cutting. These soils are suited to use as sites for septic tank absorption fields; however, the moderate slopes are a limitation. If these soils are used for sanitary facilities, the pollution of ground water is a hazard.

Capability unit VIe-6; the Renshaw soil is in Shallow to Gravel range site, the Sioux soil is in Very Shallow range site.

RdE—Renshaw-Sioux extremely stony complex, 6 to 40 percent slopes. This complex consists of moderately sloping to steep, somewhat excessively drained and excessively drained soils on gravelly upland ridges and side slopes. These soils are moderately shallow and shallow over sand and gravel. Stones are scattered on the surface throughout the unit, mainly in areas of the Sioux soil. The stones are 1 to 5 feet apart. There are a few large boulders. The areas of this map unit are irregular in shape and range from 5 to 25 acres in size. They are 45 to 55 percent Renshaw soil and 35 to 45 percent Sioux soil. The Renshaw soil is on the middle and upper parts of side slopes and on the broader ridgetops. The Sioux soil is on narrow convex ridges and sharp breaks. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Renshaw soil is dark gray loam about 6 inches thick. The subsoil is about 12 inches thick. The upper part of the subsoil is dark gray, very friable loam, and the lower part is brown and grayish brown, very friable loam. The underlying material, to a depth of 60 inches, is grayish brown and dark brown, calcareous sand and gravel. In places, the subsoil has more sand than is typical.

Typically, the surface layer of the Sioux soil is very dark gray, extremely stony sandy loam about 6 inches thick. The next layer is dark grayish brown, very friable gravelly sandy loam about 6 inches thick. The underlying material, to a depth of 60 inches, is pale brown, calcareous sand and gravel.

Included in mapping and making up less than 10 percent of any one mapped area are small areas of Fordville soils. Fordville soils are deeper to sand and gravel than the Renshaw and Sioux soils; they are on foot slopes and in swales.

Permeability in the Renshaw soil is moderately rapid in the upper part and rapid in the lower part. Permeability in the Sioux soil is rapid. The available water capacity in the Renshaw soil is low, and in the Sioux soil it is very low. Fertility in the Renshaw soil is medium or low, and in the Sioux soil it is low. The organic matter content in the Renshaw soil is moderate, and in the Sioux soil it is low. Runoff on these soils is slow to medium.

In most areas, these soils are in native grass and are used for grazing. These soils have poor potential for crops, for use as rangeland, for the development of habitat for rangeland and openland wildlife, for use as tame pasture and hayland, and for windbreaks and environmental plantings. They have poor potential for building site development and sanitary facilities.

This unit is best suited to use as rangeland. The natural plant cover is a mixture of mid and short grasses. The main management concerns are related to erosion and the low available water supply of the soils. Maintaining an adequate vegetative cover and ground mulch helps to reduce runoff, thus preventing excessive soil loss and improving the moisture supply. Overgrazing rangeland causes deterioration of the plant community; the taller, more desirable grasses are replaced by less productive short grasses and undesirable plants. A planned grazing system that includes proper grazing use and deferred grazing helps to maintain or improve range condition.

These soils generally are not suitable for crops, for use as tame pasture and hayland, or for windbreaks and environmental plantings because of the steep slopes, the surface stones, and the low available water capacity.

Suitable sites for buildings are available in some areas where the soils are less sloping and less stony; however, land shaping generally is necessary. In some steeper areas, excessive cuts are needed when grading for roads. Revegetating the back slopes is difficult because of the gravelly material that is exposed through cutting. These soils generally are too steep for use as sites for septic tank absorption fields. If these soils are used for sanitary facilities, the pollution of ground water is a hazard.

Capability unit VIIs-1; the Renshaw soil is in Shallow to Gravel range site, the Sioux soil is in Very Shallow range site.

ReA—Rentill loam, 0 to 2 percent slopes. This is a deep, well drained, nearly level soil on flat, smooth areas on uplands. The areas are irregular in shape and range from 5 to 25 acres in size.

Typically, the surface layer is dark gray loam about 7 inches thick. The subsoil is grayish brown, friable loam about 9 inches thick. The underlying material, to a depth of 22 inches, is brown sand and gravel. Below that, to a depth of 60 inches, it is grayish brown and light yellowish brown, calcareous clay loam glacial till. In places, slopes are as much as 4 percent.

Included in mapping are small areas of Fordville, Peever, and Renshaw soils. These soils make up less than 10 percent of any one mapped area. Renshaw and Fordville soils do not have glacial till within a depth of 40 inches. The Peever soil has more clay than this Rentill soil. All these soils are intermingled with the Rentill soil.

Permeability is moderate in the upper part of the soil and moderately slow in the underlying glacial till. The available water capacity is moderate or high. Fertility is medium, and the organic matter content is moderate. Runoff is slow. The underlying glacial till shrinks and swells to a large extent upon drying and wetting.

In most areas, this soil is used for farming. It has good potential for cultivated crops; for use as tame pasture, hayland, and rangeland; for windbreaks and environmental plantings; and for the development of habitat for openland and rangeland wildlife. This soil has poor potential for building site development and sanitary facilities.

This soil is suited to corn, small grains, and grasses and legumes for tame pasture and hay. If this soil is used for crops, conserving moisture is the main concern of management. The use of minimum tillage and winter cover crops helps to conserve moisture. Including grasses and legumes in the cropping system helps to maintain fertility and to increase the organic matter content.

This soil is suited to use as pasture and hayland. Overgrazing pasture causes deterioration of the plant community; the more desirable grasses lose vigor and are replaced by less productive grasses and other plants. Stocking at the proper rate, rotating grazing, controlling weeds, and deferring grazing help to keep pasture in good condition. Seeding adapted grasses helps to increase production.

This soil is well suited to use as sites for windbreaks and environmental plantings if trees and shrubs are selected that do not have a high moisture requirement. All climatically adapted trees and shrubs grow well if the competing vegetation is controlled. Good site preparation, cultivation, and the use of herbicides help in controlling competing vegetation. Leaving the site fallow for a year prior to planting helps to eliminate grasses and weeds and to conserve moisture.

If buildings are constructed on this soil, foundations and footings should be reinforced to help prevent structural damage by the shrinking and swelling of the soil. Local roads should be constructed on raised and well compacted material to help prevent damage to the road by frost action and by shrinking and swelling. If this soil is used as a site for septic tank absorption fields, the absorption area needs to be enlarged to help overcome the slow absorption of liquid waste. Sewage lagoons can be used for onsite waste disposal; however, the upper loamy and gravelly layers should be sealed to prevent seepage.

Capability unit IIs-3; Silty range site.

SaE—Sioux-Renshaw complex, 15 to 40 percent slopes. This complex consists of moderately steep and steep, excessively drained and somewhat excessively drained soils on upland ridges and side slopes. These soils are shallow over sand and gravel. In places, a few stones are scattered on the ridgetops. The areas of this map unit are irregular in shape and range from 5 to 40 acres in size. They are 60 to 70 percent Sioux soil and 25 percent Renshaw soil. The Sioux soil is on knolls, ridges, and slope breaks. The Renshaw soil is on the lower part of side slopes. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Sioux soil is very dark gray sandy loam about 6 inches thick. The next layer is dark grayish brown gravelly sandy loam about 6 inches thick. The underlying material, to a depth of 60 inches, is pale brown, calcareous sand and gravel.

Typically, the surface layer of the Renshaw soil is dark gray loam about 6 inches thick. The subsoil is about 12 inches thick. The upper part of the subsoil is dark gray, very friable loam, and the lower part is brown and grayish brown, very friable loam. The underlying material, to a depth of 60 inches, is grayish brown and dark brown, calcareous sand and gravel. In places, the subsoil has more sand than is typical.

Included in mapping and making up about 10 percent of the unit are small areas of Fordville soils. Fordville soils are on foot slopes and in swales; they are deeper to sand and gravel than the Sioux and Renshaw soils.

Permeability in the Sioux soil is rapid, and in the Renshaw soil it is moderately rapid in the subsoil and rapid in the underlying sand and gravel. The available water capacity in the Sioux soil is very low, and in the Renshaw soil it is low. Fertility in the Sioux soil is low, and in the Renshaw soil it is medium or low. The organic matter content in the Sioux soil is low, and in the Renshaw soil it is moderate. Runoff on these soils is slow or medium.

In most areas, these soils are in native grass and are used for grazing. They have poor potential for crops; for use as rangeland, tame pasture, and hayland; for windbreaks and environmental plantings; and for the development of habitat for openland and rangeland wildlife. These soils have poor potential for building site development and sanitary facilities.

The soils in this unit are best suited to use as rangeland. The natural plant cover is a mixture of mid and short grasses. The main limitations are the hazard of erosion and the low available water capacity of the soils. Maintaining an adequate vegetative cover helps to reduce runoff, thus preventing excessive soil loss and improving the moisture supply. Overgrazing rangeland reduces the vegetative cover and causes deterioration of the plant community. The taller, more desirable grasses are replaced by less productive short grasses. A planned grazing system that includes proper grazing use and deferred grazing helps to maintain or improve range condition and helps to control erosion.

These soils are not suited to crops, tame pasture, or windbreaks and environmental plantings because of the steep slopes and the low available water capacity.

These soils generally are too steep for most building site development and sanitary facilities. Because of the hazard of seepage in the underlying sand and gravel, all sanitary facilities can pollute the ground water.

Capability unit VIIs-2; the Sioux soil is in Very Shallow range site, the Renshaw soil is in Shallow to Gravel range site.

SbE—Sisseton loam, 15 to 40 percent slopes. This is a deep, well drained, moderately steep or steep soil bordering drainageways and lakes on uplands. In places, there are few to many medium and large stones on the surface. In the higher areas on the landscape, slopes are short and convex. Some areas are dissected by deep drainageways. The areas of this map unit are long narrow bands that range from 5 to 150 acres in size.

Typically, the surface layer is light brownish gray, calcareous loam about 7 inches thick. The underlying material, to a depth of about 17 inches, is light gray, very friable, calcareous loam. Below that, to a depth of 60 inches, it is pale yellow, very friable, calcareous loam. In places, the surface layer is sandy loam, and strata of loamy fine sand are in the upper part of the soil.

Included in mapping are small areas of the well drained Heimdal soils and the moderately well drained Svea soils. These soils make up less than 15 percent of any one mapped area. Heimdal soils are on the middle and lower parts of side slopes; they have a darker surface layer than this Sisseton soil. Svea soils are on foot slopes and in swales. Renshaw and Sioux soils are in areas where there are small pockets of sand and gravel.

Permeability is moderate. The available water capacity is high. Fertility and the organic matter content are low. Runoff is rapid.

This soil is best suited to use as range. The natural plant cover is a mixture of tall, mid, and short grasses. Controlling excessive runoff and erosion is the main management concern. Maintaining an adequate vegetative cover and ground mulch helps to prevent excessive soil loss and to improve the supply of moisture for rangeland plants. Overgrazing rangeland causes deterioration of the plant community; the taller, more productive grasses are replaced by less productive short grasses and undesirable plants. A planned grazing system that includes proper grazing use and deferred grazing helps to maintain or improve range condition and helps to control erosion.

This soil is not suitable for farming or for windbreaks if the trees and shrubs are planted using machinery. It can be used for adapted trees and shrubs that are planted by hand and given special care.

This soil is too steep for building site development and sanitary facilities. If roads are constructed on this soil, grading and compacting the base material help to prevent damage to the road resulting from frost action and the low strength of the soil. Mulching and seeding adapted grasses help to control roadside erosion and to prevent gully erosion in borrow areas.

Capability unit VIIe-1; Thin Upland range site.

ScD—Sisseton-Heimdal loams, 9 to 15 percent slopes. These are deep, well drained, strongly sloping and rolling soils on uplands. Some areas are dissected by shallow drainageways. A few stones are scattered on the surface in some areas. In the higher areas on the landscape, slopes are short and convex. In cultivated areas, there are many light colored spots on the knolls and ridgetops (fig. 10). The areas of this map unit range from 5 to 30 acres in size and are long and narrow in shape. They are 40 to 50 percent Sisseton soil and 25 to 35 percent Heimdal soil. The Sisseton soil is on the higher part of knolls and ridges. The Heimdal soil is on the middle and lower parts of plane or convex side slopes. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Sisseton soil is light brownish gray, calcareous loam about 7 inches thick. The underlying material, to a depth of about 17 inches, is light gray, very friable, calcareous loam. Below that, to a depth of 60 inches, it is pale yellow, very friable, calcareous loam. In places, the surface layer is sandy loam, and strata of loamy fine sand are in the upper part of the soil.

Typically, the surface layer of the Heimdal soil is dark gray loam about 8 inches thick. The subsoil is friable loam about 14 inches thick. The upper part of the subsoil is dark grayish brown, and the lower part is brown. The underlying material, to a depth of 60 inches, is light gray and pale yellow, calcareous loam. In places where the original surface layer has been mixed with material from the subsoil by plowing, the present surface layer is thinner and lighter in color.

Included in mapping are small areas of the moderately well drained Svea soils and the poorly drained Tonka and Vallers soils. Also included are areas of Renshaw and Sioux soils. These soils make up less than 25 percent of any one mapped area. Svea soils are on the lower part of foot slopes and in swales. Tonka soils are in shallow depressions. Vallers soils are on the edge of the depressions. Renshaw and Sioux soils are in areas where there are pockets of sand and gravel.

Permeability in these soils is moderate, and the available water capacity is high. Fertility in the Sisseton soil is low, and in the Heimdal soil it is medium or high. The organic matter content in the Sisseton soil is low, and in the Heimdal soil it is moderate or high. Runoff on these soils is medium or rapid.

In most areas, these soils are used for farming. In a few areas, they are in native grass and are used for grazing or hay. The Sisseton soil has fair potential for use as tame pasture, hayland, and rangeland and for the development of habitat for rangeland wildlife. It has poor potential for crops, for windbreaks and environmental plantings, and for the development of habitat for openland wildlife. The Heimdal soil has fair potential for crops and for the development of habitat for openland wildlife. It has good potential for use as rangeland, tame pasture, and hayland; for windbreaks and environmental plantings; and for the development of habitat for rangeland wildlife.

The soils in this unit are poorly suited to cultivated crops. If these soils are used for crops, controlling ero-

Figure 10.—An area of Sisseton-Heimdal loams, 9 to 15 percent slopes. The Sisseton soil is in the light-colored areas.

sion and maintaining fertility are the main concerns of management. The high content of lime in the surface layer of the Sisseton soil restricts the availability of plant nutrients. The fertility of these soils has been reduced by erosion. Minimum tillage, the use of close-growing crops, and grassed waterways help to prevent excessive soil loss. In areas where they are suitable, terraces also are effective in controlling erosion. Returning crop residue and adding other organic material to the soil help to improve fertility and to increase the water intake rate.

Using these soils as tame pasture or hayland also is effective in controlling erosion. The Heimdal soil is suited to all climatically adapted pasture plants. The choice of plants on the Sisseton soil is limited. Reseeding adapted grasses and applying fertilizer help to establish a good vegetative cover. Stocking at the proper rate, rotating grazing, controlling weeds, applying fertilizer, and deferring grazing help to keep pasture in good condition.

This unit is well suited to use as rangeland. The natural plant community is a mixture of tall, mid, and short grasses. Overgrazing causes deterioration of the plant community; the taller, more desirable grasses lose vigor and are replaced by less productive short grasses. A planned grazing system that includes proper grazing use and deferred grazing helps to maintain or improve the range condition of native pasture. Seeding rangeland helps to improve rangeland that is in poor condition.

The Sisseton soil is poorly suited to use as sites for windbreaks and environmental plantings; the Heimdal soil is well suited to this use. All climatically adapted trees and shrubs on the Heimdal soil grow well if the competing vegetation is controlled. Leaving the site fallow for a year prior to planting helps to eliminate grasses and weeds and to conserve moisture. Planting trees on the contour helps to control erosion and conserve moisture.

If these soils are used as sites for buildings, considerable land leveling and shaping is necessary because of the steepness of slopes. Roads should be constructed on raised and well compacted material to help prevent road damage resulting from frost action and the low strength of the soil. Seeding adapted grasses helps to control roadside erosion and to prevent gully erosion in borrow areas. The best sites for septic tank absorption

fields are in the less sloping areas. These soils are poorly suited to sewage lagoons because of the steepness of slopes and the hazard of seepage.

The Sisseton soil is in capability unit VIe-3, Thin Upland range site; the Heimdal soil is in capability unit IVe-1, Silty range site.

Sd—Svea loam. This is a deep, moderately well drained, nearly level soil on flats and in slightly concave swales. This soil is frequently flooded for a very brief period. Some areas are dissected by shallow drainageways. The areas of this map unit are narrow in shape and range from 5 to 18 acres in size.

Typically, the surface layer is dark gray loam about 13 inches thick. The subsoil is friable loam about 15 inches thick. The upper part of the subsoil is dark grayish brown, and the lower part is grayish brown. The underlying material, to a depth of 60 inches, is light brownish gray, calcareous loam; strata of sandy loam are in the lower part. In places, the subsoil is thicker than is typical, and lime is at a greater depth. In some areas, the surface layer and subsoil have more silt and less sand than is typical.

Included in mapping are small areas of Heimdal soils on slight rises and the poorly drained Tonka soils in shallow depressions. These soils make up less than 10 percent of any one mapped area. Also included are the somewhat poorly drained Flom soils in lower lying areas of shallow drainageways.

Permeability is moderate in the subsoil and moderately slow in the underlying material. The available water capacity is high. The content of organic matter is moderate or high, and fertility is medium or high. The shrink-swell potential is moderate. Runoff is slow. Tilth is good. The water table is at a depth of 4 to 6 feet in spring.

In most areas, this soil is used for farming. It has good potential for crops; for use as tame pasture, hayland, and rangeland; for windbreaks and environmental plantings; and for the development of habitat for openland wildlife. It has fair potential for the development of habitat for rangeland wildlife. This soil has poor potential for building site development and for most sanitary facilities.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for pasture and hay. The main concerns of management are maintaining fertility and the organic matter content. In some years, cultivation is delayed because the soil receives runoff from adjacent soils. The use of minimum tillage, crop residue, and grasses and legumes in the cropping system helps to improve fertility and the organic matter content. Grassed waterways are effective in preventing gully erosion.

This soil is well suited to use as tame pasture or hayland. It is suited to all climatically adapted pasture plants. Stocking at the proper rate, rotating grazing, deferring grazing, and applying fertilizer help to keep pasture in good condition.

This soil is well suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs grow well if the competing vegetation is controlled. Fallowing the site prior to planting, cultivation, and the use of herbicides help in controlling competing vegetation.

This soil is poorly suited to building site development because of the hazard of flooding. Sites for buildings are available on the adjacent, well drained soils. Roads should be constructed on raised and well compacted material, and drainage should be provided to help prevent damage to the road by frost action and flooding. The base material needs to be strengthened to overcome the low strength of the soil. This soil should not be used as a site for septic tank absorption fields because of seasonal wetness and the hazard of flooding. Sites for septic tank absorption fields are available on the adjacent soils. Sewage lagoons function well on this soil.

Capability unit I-3; Overflow range site.

SeA—Swenoda fine sandy loam, 0 to 2 percent slopes. This is a deep, moderately well drained, nearly level soil on smooth upland flats. The areas are irregular in shape and range from 5 to 60 acres in size.

Typically, the surface layer is about 12 inches thick. It is dark gray fine sandy loam about 7 inches thick in the upper part and dark grayish brown fine sandy loam about 5 inches thick in the lower part. The subsoil is about 20 inches thick. The upper part of the subsoil is dark grayish brown, very friable fine sandy loam and brown, very friable sandy loam; and the lower part is light brownish gray, firm clay loam. The underlying material, to a depth of 60 inches, is light gray, calcareous clay loam. In places, glacial till is at a depth of less than 20 inches. In some areas, the upper part of this soil has more silt and clay than is typical.

Included in mapping are small areas of the well drained Egeland and Peever soils. These soils make up less than 15 percent of any one mapped area. Egeland soils are on slight rises and have more sand in the lower part than this Swenda soil. Peever soils are intermingled with this Swenoda soil and have more clay. Also included are the poorly drained Tonka soils in shallow depressions.

Permeability is moderately rapid in the upper part of the subsoil and moderate or moderately slow in the lower part of the subsoil and in the underlying material. The available water capacity is moderate or high. Fertility is medium or high, and the content of organic matter is moderate. The shrink-swell potential is low in the upper part of the subsoil and is moderate in the lower part of the subsoil and in the underlying material. The seasonal high water table is between depths of 2.5 and 4 feet.

In most areas, this soil is used for farming. It has good potential for use as tame pasture, hayland, and rangeland; for windbreaks and environmental plantings; and for the development of habitat for rangeland wildlife. It

has fair potential for crops and for the development of habitat for openland wildlife. This soil has fair potential for building site development and poor potential for most sanitary facilities.

This soil is suited to corn, soybeans, small grains, and legumes and grasses and for hay and pasture. If this soil is used for crops, controlling soil blowing is the main management concern. Minimum tillage, stripcropping, stubble mulching, returning crop residue to the soil, and field windbreaks help to control soil blowing. Returning crop residue or adding other organic material to the soil helps to improve fertility and conserve moisture.

Using this soil as tame pasture and hayland also is effective in controlling soil blowing. Stocking at the proper rate, rotating grazing, deferring grazing, applying fertilizer, and controlling weeds help to keep pasture in good condition.

This soil is well suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs grow well if the competing vegetation is controlled. Good site preparation, cultivation, and the use of herbicides help in controlling competing vegetation. A winter cover crop between the rows of trees helps to control soil blowing.

If buildings are constructed on this soil, the foundations and footings should be reinforced to help prevent structural damage by the shrinking and swelling of the soil. If this soil is used as a site for local roads and streets, the base material needs to be strengthened to help overcome the low strength of the soil. If this soil is used as a site for septic tank absorption fields, the absorption area needs to be enlarged to help overcome the slow absorption of liquid waste. If this soil is used for sewage lagoons, seepage is a hazard.

Capability unit IIIs-1; Sandy range site.

Ta—Tonka silt loam. This is a deep, poorly drained, level soil in closed depressions. This soil is subject to common flooding of long duration. The areas are circular or oval in shape and range from 2 to 10 acres in size.

Typically, the surface layer is dark gray silt loam about 10 inches thick. The subsurface layer is gray silt loam about 13 inches thick. The subsoil is about 27 inches thick. The upper part of the subsoil is dark gray, firm silty clay; the middle part is gray and olive gray, firm silty clay; and the lower part is gray, friable clay loam. The underlying material, to a depth of 60 inches, is light olive gray, mottled clay loam. In places where material from the subsurface layer has been mixed with the original surface layer by plowing, the present surface layer is light gray.

Included in mapping and making up less than 10 percent of any one mapped area are small areas of the poorly drained Vallers soils. Vallers soils are on the edge of depressions.

Permeability is slow. The available water capacity is high. Fertility is medium or high, and the content of organic matter is high. The shrink-swell potential is high in the subsoil. The seasonal water table is at the surface or within a depth of 1 foot. Unless this soil is artificially drained, it is ponded during part of the year.

In many areas, this soil has been drained and is used for farming. In some areas, it is in native grass and is used for grazing or hay. If this soil is adequately drained, it has good potential for cultivated crops and for use as tame pasture and hayland. If it has not been drained, it has fair potential for these uses. This soil has poor potential for windbreaks and environmental plantings and for the development of habitat for openland wildlife. It has fair potential for use as rangeland and for the development of habitat for rangeland wildlife. It has good potential for the development of habitat for wetland wildlife. This soil has poor potential for building site development and sanitary facilities.

If this soil is adequately drained, it is suited to corn, small grains, and grasses and legumes for pasture and hay. If this soil is used for crops, wetness is the main management concern. Wetness commonly delays farming operations in most years. Crop residue management, the use of green manure crops, and timely tillage help to maintain fertility and tilth. In areas where drainage is feasible, controlling runoff from adjacent soils and using diversions and open drains help to control wetness.

This soil is suited to use as tame pasture, hayland, or rangeland. Seeding pasture plants that are tolerant of wetness is essential for maximum production in drained or undrained areas. Stocking at the proper rate, deferring grazing, rotating grazing, and restricting use in wet periods help to keep pasture in good condition. A planned grazing system that includes proper grazing use and deferred grazing helps to maintain or improve the condition of rangeland.

This soil is not suited to use as sites for windbreaks and environmental plantings if the trees and shrubs are planted using machinery. This soil can be used for adapted trees and shrubs in areas where it has been drained and protected from flooding.

This soil generally is not suitable for most building site development because of the hazards of wetness and flooding. To help prevent road damage resulting from flooding and the low strength of the soil, local roads should be constructed on raised and well compacted, better suited material obtained offsite. This soil is poorly suited to use as septic tank absorption fields because of the hazards of wetness and flooding. Sewage lagoons function well on this soil.

Capability unit IIw-1, drained, IVw-2, undrained; Wetland range site.

Va—Vallers loam. This is a deep, poorly drained, nearly level soil on flats and in shallow drainageways. This soil is subject to rare flooding. In places, stones and cobblestones are scattered on the surface. The areas

are irregular in shape and range from 5 to 150 acres in size.

Typically, the surface layer is dark gray, calcareous loam about 15 inches thick. The next layer is dark gray, friable, calcareous loam about 6 inches thick. The underlying material, to a depth of 32 inches, is gray, calcareous loam. Below that, to a depth of 60 inches, it is light gray, calcareous loam. In places where material from lower layers has been mixed with the original surface layer by plowing, the present surface layer is gray. In some areas, strata of loamy and sandy material are below a depth of 40 inches.

Included in mapping are small areas of the poorly drained Parnell and Tonka soils. These soils make up less than 10 percent of any one mapped area. They are in shallow depressions.

Permeability is moderately slow. The available water capacity is high. Fertility is medium, and the content of organic matter is moderate. The shrink-swell potential is moderate. Runoff is slow. A fluctuating water table is between depths of 1 foot and 2.5 feet during part of the growing season.

In most areas, this soil is used for farming. In some areas, it is in native grass and is used for grazing or hay. This soil has fair potential for crops, for use as tame pasture and hayland, and for the development of habitat for rangeland wildlife. It has good potential for use as rangeland and for windbreaks and environmental plantings. This soil has poor potential for building site development and sanitary facilities. If this soil is drained, it has good potential for crops and for use as tame pasture and hayland.

If this soil is adequately drained, it is suited to corn, small grains, and grasses and legumes for pasture and hay. If this soil is used for crops, controlling wetness and maintaining fertility are the main management concerns. Controlling soil blowing also is a concern. Controlling runoff from adjacent soils and providing drainage structures can help to improve drainage. The use of minimum tillage and winter cover crops helps to prevent soil blowing. Returning crop residue to the soil, the use of green manure crops, and timely tillage help to maintain fertility and tilth.

This soil is well suited to use as tame pasture or hayland. In undrained areas, the high water table limits the choice of adapted grasses that can be grown. Controlling runoff from adjacent soils and providing drainage increase the choice of adapted grasses. Stocking at the proper rate, rotating grazing, deferring grazing, controlling weeds, applying fertilizer, and restricting use in wet periods help to keep pasture in good condition.

This soil is well suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs grow well because the supply of available moisture is good. In undrained areas, shallowness to the water table can restrict root development. Competing vegetation can be controlled through good site preparation, cultivation, and the use of herbicides.

This soil generally is too wet for building site development and sewage lagoons. Local roads should be constructed on raised and well compacted material to help prevent damage to the road resulting from frost action and the low strength of the soil.

Capability unit IIw-2, drained, IVw-2, undrained; Subirrigated range site.

Vb—Vallers-Parnell complex. This complex consists of deep, poorly drained and very poorly drained, nearly level soils on flats and in swales and shallow depressions. The Vallers soil is subject to rare flooding. The Parnell soil is subject to frequent flooding. In some areas of the Vallers soil, stones and cobblestones are scattered on the surface. The areas of this map unit are irregular in shape and range from 5 to 80 acres in size. They are 50 to 60 percent Vallers soil and 30 to 40 percent Parnell soil. The Vallers soil is in shallow swales and on flats around and between areas of the Parnell soil. The Parnell soil is in wet depressions. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Vallers soil is dark gray, calcareous loam about 15 inches thick. The next layer is dark gray, friable, calcareous loam about 6 inches thick. The underlying material, to a depth of 32 inches, is gray, calcareous loam. Below that, to a depth of 60 inches, it is light gray, calcareous clay loam.

Typically, the surface layer of the Parnell soil is very dark gray silty clay loam about 11 inches thick. The subsoil is firm silty clay about 43 inches thick. The upper part of the subsoil is very dark gray, the middle part is dark gray, and the lower part is gray. The underlying material, to a depth of 60 inches, is gray silty clay.

Included in mapping are small areas of the poorly drained Flom soils on slight rises and the poorly drained Tonka soils in shallow potholes. These soils make up less than 10 percent of any one mapped area.

Permeability in the Vallers soil is moderately slow, and in the Parnell soil it is slow. The available water capacity in the Vallers soil is high, and in the Parnell soil it is moderate or high. Fertility in the Vallers soil is medium, and in the Parnell soil it is high. The organic matter content in the Vallers soil is moderate, and in the Parnell soil it is high. The shrink-swell potential in the Vallers soil is moderate, and in the Parnell soil it is high. Runoff on the Vallers soil is slow; it is ponded on the Parnell soil. The Vallers soil has a water table that fluctuates between depths of 1 foot and 2.5 feet during part of the growing season. The Parnell soil has a water table that is at the surface or within a depth of 2 feet most of the year.

In most areas, these soils are in native grass and are used for grazing. They generally have fair potential for crops, for the development of habitat for rangeland wild-

life, and for use as tame pasture, hayland, and rangeland. The Vallers soil has good potential for windbreaks and environmental plantings, and the Parnell soil has poor potential. Providing drainage improves the potential of these soils for some uses. These soils have poor potential for building site development and most sanitary facilities.

The soils in this unit are best suited to use as rangeland. The natural plant cover is a mixture of tall, mid, and short grasses. Overgrazing rangeland causes deterioration of the plant community; the taller, more desirable grasses are replaced by less productive grasses and other undesirable plants. A planned grazing system that includes proper grazing use and deferred grazing helps to maintain or improve range condition.

If adequately drained, these soils are suited to crops and to use as tame pasture and hayland; however, planting and harvesting commonly are delayed because of wetness and flooding.

The Vallers soil can be used as a site for windbreaks and environmental plantings. All climatically adapted trees and shrubs grow well because the moisture supply is good; however, in undrained areas, shallowness to the water table can restrict root development. The Parnell soil is not suited to use as sites for windbreaks and environmental plantings.

These soils are poorly suited to building site development and sanitary facilities because of wetness and the hazard of flooding. To help prevent road damage resulting from wetness, frost action, and low soil strength in areas of the Vallers soil, local roads should be constructed on raised and well compacted material. To help prevent road damage resulting from flooding, wetness, and low soil strength in areas of the Parnell soil, roads should be constructed on raised and well compacted, better suited material obtained offsite.

The Vallers soil is in capability unit IIw-2, drained, and IVw-2, undrained; Subirrigated range site. The Parnell soil is in capability unit IIIw-1, drained, and Vw-2, undrained; Wetland range site.

Vc—Vallers-Tonka complex. This complex consists of deep, poorly drained, nearly level soils on flats and in swales and shallow depressions. The Tonka soil is frequently flooded by runoff from adjacent soils. The areas of this map unit are irregular in shape and range from 5 to 100 acres in size. They are 50 to 60 percent Vallers soil and 30 to 40 percent Tonka soil. The Vallers soil is in shallow swales and on flats around and between areas of the Tonka soil. The Tonka soil is in shallow depressions. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Vallers soil is dark gray, calcareous loam about 15 inches thick. The next layer is dark gray, friable, calcareous loam about 6 inches thick. The underlying material, to a depth of 32 inches, is gray, calcareous loam. Below that, to a depth of 60 inches, it is light gray, calcareous clay loam. In some areas, strata of loamy and sandy material are below a depth of 40 inches.

Typically, the surface layer of the Tonka soil is dark gray silt loam about 10 inches thick. The subsurface layer is gray silt loam about 13 inches thick. The subsoil is about 27 inches thick. The upper part of the subsoil is dark gray, firm silty clay; the middle part is gray and olive gray, firm silty clay; and the lower part is gray, friable clay loam. The underlying material, to a depth of 60 inches, is light olive gray, mottled clay loam. In places where material from the subsurface layer has been mixed with the original surface layer by plowing, the present surface layer is light gray.

Included in mapping are small areas of the poorly drained Flom soils on slight rises and the poorly drained Parnell soils in wet depressions. These soils make up less than 10 percent of any one mapped area.

Permeability in the Vallers soil is moderately slow, and in the Tonka soil it is slow. Fertility in the Vallers soil is medium, and in the Tonka soil it is medium or high. The organic matter content in the Vallers soil is moderate, and in the Tonka soil it is high. Runoff is slow or ponded. The Vallers soil has a water table between depths of 1 foot and 2.5 feet during part of the growing season. The Tonka soil has a water table between depths of 3 and 5 feet most of the year.

In most areas, these soils are used for farming. In some areas, they are in native grass and are used for grazing and hay. These soils generally have fair potential for crops, for the development of habitat for rangeland wildlife, and for use as tame pasture, hayland, and rangeland. The Vallers soil has good potential for windbreaks and environmental plantings, and the Tonka soil has poor potential. Drainage can improve the potential of these soils for some uses. These soils have poor potential for building site development and for most sanitary facilities.

If these soils are adequately drained, they are suited to corn, small grains, and grasses and legumes for pasture and hay. If these soils are used for crops, controlling wetness and maintaining fertility and tilth are the main management concerns. The Vallers soil is subject to soil blowing if it is left unprotected. The high content of lime in the root zone limits the availability of plant nutrients. Controlling runoff from adjacent soils and providing drainage structures help to control flooding. The use of minimum tillage and winter cover crops helps to prevent soil blowing. Returning crop residue to the soil, the use of green manure crops, and timely tillage help to maintain fertility and tilth.

The soils in this unit are suited to use as tame pasture and hayland. Grasses or legumes that are adapted to the wetness of these soils should be used in drained or undrained areas for maximum production. Stocking at the proper rate, rotating grazing, applying fertilizer, defer-

ring grazing, and restricting use in wet periods help to keep pasture in good condition.

The Vallers soil can be used as a site for windbreaks and environmental plantings. The Tonka soil is not suited to this use because it is too poorly drained.

These soils are poorly suited to building site development and sanitary facilities because of wetness and the hazard of flooding. In areas of the Vallers soil, local roads should be constructed on raised and well compacted material to help prevent damage to the road resulting from frost action, flooding, and low strength. In areas of the Tonka soil, roads should be constructed on raised and well compacted, better suited material obtained offsite. These soils generally are not suitable for use as sites for septic tank absorption fields because of the high water table. Sewage lagoons can be used for onsite waste disposal in areas of the Tonka soil.

The Vallers soil is in capability unit IIw-2, drained, and IVw-2, undrained; Subirrigated range site. The Tonka soil is in capability unit IIw-1, drained, and IVw-2, undrained; Wetland range site.

VdD—Vienna-Buse complex, 9 to 15 percent slopes. This complex consists of deep, well drained, strongly sloping soils on upland ridges and side slopes. In some areas, stones or cobblestones are scattered on the surface. A few areas are dissected by shallow drainageways. The areas of this map unit are irregular in shape and range from 4 to 95 acres in size. They are 45 to 55 percent Vienna soil and 25 to 35 percent Buse soil. The Vienna soil is on the middle and lower parts of side slopes. The Buse soil is in the higher positions on the landscape. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Vienna soil is dark gray silt loam about 10 inches thick. The subsoil is about 18 inches thick. The upper part of the subsoil is dark grayish brown, friable silt loam; and the lower part is grayish brown and light yellowish brown, friable, calcareous clay loam. The underlying material, to a depth of 60 inches, is pale yellow, calcareous loam. In places, the surface layer and subsoil are thinner than is typical.

Typically, the surface layer of the Buse soil is dark gray loam about 7 inches thick. The underlying material, to a depth of about 22 inches, is light brownish gray, friable, calcareous clay loam. Below that, to a depth of 60 inches, it is light gray, calcareous clay loam. In places, the surface layer is thinner than is typical or has been removed through erosion.

Included in mapping are small areas of Lismore and Vallers soils. These soils make up less than 20 percent of any one mapped area. Lismore soils are moderately well drained and are on foot slopes and in swales. Vallers soils are poorly drained and are in some of the wetter drainageways.

Permeability in the Buse soil is moderately slow. In the Vienna soil, permeability is moderate in the upper part of the subsoil and moderately slow in the lower part of the subsoil and in the underlying material. Fertility in the Vienna soil is medium or high, and in the Buse soil it is low or medium. The organic matter content in the Vienna soil is moderate or high, and in the Buse soil it is moderate or low. The available water capacity of these soils is high. The shrink-swell potential is moderate. Runoff is medium or rapid.

In most areas, these soils are in native grass and are used for grazing or hay. The Vienna soil has good potential for the development of habitat for rangeland wildlife and for use as tame pasture, hayland, and rangeland. It has fair potential for crops and for the development of habitat for openland wildlife. The Buse soil has fair potential for the development of habitat for rangeland wildlife and for use as tame pasture, hayland, and rangeland. It has poor potential for crops and for the development of habitat for openland wildlife. These soils have fair potential for building site development and poor potential for most sanitary facilities.

The soils in this unit are best suited to use as rangeland. The natural plant cover is a mixture of tall, mid, and short grasses. Maintaining an adequate vegetative cover and ground mulch help to prevent excessive soil loss and to improve the supply of moisture for rangeland plants. Overgrazing rangeland causes deterioration of the plant community; the taller, more productive grasses are replaced by less productive short grasses and undesirable plants. Proper stocking rates, uniform grazing distribution, and timely deferment of grazing help to maintain or improve range condition and to control erosion.

These soils generally are poorly suited to crops. If these soils are used for crops, controlling erosion and conserving moisture are the main concerns of management. Minimum tillage, returning crop residue to the soil, and seeding adapted grasses and legumes for pasture and hay help to control erosion.

These soils are not suited to use as sites for windbreaks and environmental plantings if the trees and shrubs are planted using machinery. They can be used for adapted trees and shrubs that are planted by hand and given special care.

If buildings are constructed on these soils, the foundations and footings should be reinforced to help prevent structural damage caused by the shrinking and swelling of the soil. Land leveling and shaping generally are required because of the steepness of slopes. Local roads should be constructed on raised and well compacted material to help prevent road damage caused by the low strength of the soil. Seeding adapted grasses helps to control roadside erosion and to prevent gully erosion in borrow areas. If these soils are used for septic tank absorption fields, the absorption area needs to be enlarged to help overcome the slow absorption of liquid

waste. If these soils are used for sewage lagoons, considerable land leveling and shaping are required.

The Vienna soil is in capability unit IVe-1, Silty range site; the Buse soil is in capability unit VIe-3, Thin Upland range site.

VeA—Vienna-Lismore silt loams, 0 to 2 percent slopes. These are deep, well drained and moderately well drained, nearly level soils on broad, smooth uplands. Slopes are long and gentle. The Lismore soil is subject to common flooding of brief duration. In many cultivated areas, stones and cobblestones are on the surface. The areas of this map unit range from 8 to several hundred acres in size. They are 60 to 70 percent Vienna soil and 20 to 30 percent Lismore soil. The Vienna soil is on very slight rises, and the Lismore soil is in slight swales and on foot slopes. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Vienna soil is dark gray silt loam about 10 inches thick. The subsoil is about 18 inches thick. The upper part of the subsoil is dark grayish brown, friable silt loam; and the lower part is grayish brown and light yellowish brown, friable, calcareous clay loam. The underlying material, to a depth of 60 inches, is pale yellow, calcareous loam. In places where tillage has mixed the original surface layer with material from the subsoil, the present surface layer is loam.

Typically, the surface layer of the Lismore soil is about 11 inches thick. It is dark gray silt loam about 7 inches thick in the upper part and dark gray silt loam about 4 inches thick in the lower part. The subsoil is about 18 inches thick. The upper part of the subsoil is gray, friable silt loam; and the lower part is brown and light olive brown, friable clay loam. The underlying material, to a depth of 60 inches, is light yellowish brown, calcareous loam. In places, the surface layer is loam.

Included in mapping are small areas of Brookings, Tonka, and Vallers soils. These soils make up less than 10 percent of any one mapped area. Brookings soils have more silt and less sand in the subsoil and are in slight swales where the silt mantle is more than 20 inches thick. Tonka soils are poorly drained and are in shallow depressions. Vallers soils are poorly drained and are on edge of the depressions and along shallow drainageways.

Permeability in these soils is moderate in the upper part of the subsoil and moderately slow in the lower part of the subsoil and in the underlying material. The available water capacity is high. Fertility is medium or high, and the content of organic matter is moderate or high. The shrink-swell potential is moderate. Runoff is slow. The Lismore soil has a water table between depths of 3 and 6 feet during part of the year.

In most areas, these soils are used for farming. They have good potential for crops; for use as tame pasture, hayland, and rangeland; for windbreaks and environmental plantings; and for the development of habitat for openland wildlife. The Vienna soil has good potential for the development of habitat for rangeland wildlife, and the Lismore soil has fair potential. The Vienna soil has fair potential for building site development and sanitary facilities. The Lismore soil has poor potential for building site development and sanitary facilities.

These soils are suited to corn, sunflowers, small grains, and grasses and legumes for hay and pasture. If these soils are used for crops, maintaining fertility is the main concern of management. Minimum tillage, returning crop residue to the soil, and using grasses and legumes in the cropping system help to improve fertility and the organic matter content.

Using these soils as tame pasture or hayland also is effective in maintaining or improving fertility and the organic matter content. These soils are suited to all climatically adapted pasture plants. Stocking at the proper rate, rotating grazing, controlling weeds, reseeding for stand improvement, and deferring grazing help to keep pasture in good condition.

These soils are well suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs grow well. Leaving the site fallow for a year prior to planting helps to eliminate grasses and weeds and to conserve moisture. Competing vegetation can be controlled through cultivation and the use of herbicides.

The Lismore soil is poorly suited to building site development because it is subject to flooding and seasonal wetness. If the Vienna soil is used as a site for buildings, foundations and footings should be reinforced to help prevent structural damage resulting from the shrinking and swelling of the soil. Local roads should be constructed on raised and well compacted material to help prevent road damage resulting from frost action and the low strength of these soils. The Lismore soil is poorly suited to use as septic tank absorption fields because it is subject to flooding and seasonal wetness. If the Vienna soil is used for septic tank absorption fields, the absorption area needs to be enlarged because of the restricted permeability of this soil. These soils have few limitations to use as sites for sewage lagoons.

Capability unit I-2; the Vienna soil is in Silty range site, the Lismore soil is in Overflow range site.

VeB—Vienna-Lismore silt loams, 1 to 6 percent slopes. These are deep, well drained and moderately well drained, gently sloping soils on long, smooth slopes, on rounded knolls, and in swales. The Lismore soil is subject to common flooding of brief duration. Most areas are dissected by shallow drainageways. In most cultivated areas, stones and cobblestones are on the surface of the soil. The areas of this map unit range from 6 to several hundred acres in size. They are 55 to 65 percent Vienna soil and 25 to 35 percent Lismore soil. The Vienna soil is on knolls and on the middle and upper

parts of side slopes. The Lismore soil is on foot slopes and in swales. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Vienna soil is dark gray silt loam about 10 inches thick. The subsoil is about 18 inches thick. The upper part of the subsoil is dark grayish brown, friable silt loam; and the lower part is grayish brown and light yellowish brown, friable, calcareous clay loam. The underlying material, to a depth of 60 inches, is pale yellow, calcareous loam. In places where tillage has mixed the original surface layer with material from the subsoil, the present surface layer is loam.

Typically, the surface layer of the Lismore soil is about 11 inches thick. It is dark gray silt loam about 7 inches thick in the upper part and dark gray silt loam about 4 inches thick in the lower part. The subsoil is about 18 inches thick. The upper part of the subsoil is gray, friable silt loam; and the lower part is brown and light olive brown, friable clay loam. The underlying material, to a depth of 60 inches, is light yellowish brown, calcareous loam. In places, the surface layer is loam. In some areas along drainageways, lime is at a lesser depth than is typical.

Included in mapping are small areas of Barnes, Brookings, Forman, Tonka, and Vallers soils. These soils make up less than 10 percent of any one mapped area. Barnes and Forman soils are on knolls and ridges; they have more sand and clay in the surface layer and subsoil than Vienna and Lismore soils. Brookings soils have more silt; they are on foot slopes and in swales. The poorly drained Tonka soils are in shallow depressions. Vallers soils are in drainageways and on the edge of shallow depressions.

Permeability in these soils is moderate in the upper part of the subsoil and moderately slow in the lower part of the subsoil and in the underlying material. The available water capacity is high. Fertility is medium or high, and the organic matter content is moderate or high. The shrink-swell potential is moderate. Runoff is medium. The Lismore soil has a water table between depths of 3 and 6 feet during part of the year.

In most areas, these soils are used for farming. In a few areas, they are in native grass and are used for grazing or hay. These soils have good potential for crops; for use as tame pasture, hayland, and rangeland; for windbreaks and environmental plantings; and for the development of habitat for openland and rangeland wildlife. The Vienna soil has fair potential for building site development and sanitary facilities. The Lismore soil has poor potential for building site development and sanitary facilities.

These soils are suited to corn, sunflowers, small grains, and grasses and legumes for pasture and hay. If these soils are used for crops, controlling erosion is the main concern of management. Minimum tillage, contour farming, terracing, and grassed waterways help to control erosion. Returning crop residue to the soil and using grasses and legumes in the cropping system help to improve fertility and to increase water infiltration.

Using these soils as tame pasture or hayland also is effective in controlling erosion. These soils are suited to all climatically adapted pasture plants. Stocking at the proper rate, rotating grazing, controlling weeds, applying fertilizer, and rotating pasture help to keep pasture in good condition.

These soils are well suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs grow well if the competing vegetation is controlled. Competing vegetation can be controlled through cultivation and the use of herbicides. Leaving the site fallow for a year prior to planting helps to eliminate grasses and weeds and to conserve moisture.

The Lismore soil is poorly suited to building site development because it is subject to flooding and seasonal wetness. If the Vienna soil is used as a site for buildings, foundations and footings should be reinforced to help prevent structural damage caused by the shrinking and swelling of the soil. Local roads should be constructed on raised and well compacted material to help prevent road damage resulting from frost action and the low strength of these soils. The Lismore soil is poorly suited to use as septic tank absorption fields because it is subject to flooding and seasonal wetness. If the Vienna soil is used for septic tank absorption fields, the absorption area needs to be enlarged because of the restricted permeability of this soil. The Lismore soil has few limitations to use as sites for sewage lagoons. If the Vienna soil is used for sewage lagoons, the surface needs to be shaped.

Capability unit IIe-2; Silty range site.

VeC—Vienna-Lismore silt loams, 3 to 9 percent slopes. These are deep, well drained and moderately well drained, gently sloping and moderately sloping soils on ridges and side slopes and in swales. The Lismore soil is subject to common flooding of brief duration. In some areas, a few stones and cobblestones are scattered on the surface. The areas of this map unit generally are long and narrow in shape and range from 5 to 165 acres in size. They are 55 to 65 percent Vienna soil and 25 to 35 percent Lismore soil. The Vienna soil is on the middle and upper parts of plane and convex side slopes and on the top of knolls. The Lismore soil is on the lower part of side slopes and in swales. These soils are so intermingled that it is not practical to separate them in mapping at the scale used.

Typically, the surface layer of the Vienna soil is dark gray silt loam about 10 inches thick. The subsoil is about 18 inches thick. The upper part of the subsoil is dark grayish brown, friable silt loam; and the lower part is grayish brown and light yellowish brown, friable, calcareous clay loam. The underlying material, to a depth of 60

inches, is pale yellow, calcareous loam. In areas where material from the subsoil has been mixed with the original surface layer by plowing, the present surface layer is loam or light clay loam.

Typically, the surface layer of the Lismore soil is about 11 inches thick. It is dark gray silt loam about 7 inches thick in the upper part and dark gray silt loam about 4 inches thick in the lower part. The subsoil is about 18 inches thick. The upper part of the subsoil is gray, friable silt loam; and the lower part is brown and light olive brown, friable, calcareous clay loam. The underlying material, to a depth of 60 inches, is light yellowish brown, calcareous loam. In places, the surface layer is loam. In areas where this soil is along drainageways, lime is at a lesser depth.

Included in mapping are small areas of Buse and Vallers soils. These soils make up less than 10 percent of any one mapped area. Buse soils have a thin surface layer and are on ridgetops. Vallers soils are in the wetter drainageways.

Permeability in these soils is moderate in the upper part of the subsoil and moderately slow in the lower part of the subsoil and in the underlying material. The available water capacity is high. Fertility is medium or high, and the organic matter content is moderate or high. The shrink-swell potential is moderate. Runoff is medium. The Lismore soil has a water table between depths of 3 and 6 feet during part of the year.

In most areas, these soils are used for farming. In a few areas, they are in native grass and are used for grazing or hay. These soils have good potential for use as tame pasture, hayland, and rangeland; for windbreaks and environmental plantings; and for the development of habitat for openland and rangeland wildlife. They have fair potential for crops. The Vienna soil has fair potential for building site development and sanitary facilities, and the Lismore soil has poor potential for these uses.

These soils are suited to small grains and to grasses and legumes for hay and pasture. If these soils are used for crops, controlling erosion is the main concern of management. Minimum tillage, contouring, terraces, grassed waterways, and the use of close-growing crops help to prevent excessive soil loss. Returning crop residue to the soil and the use of grasses and legumes in the cropping system help to improve fertility and to increase water infiltration.

Using these soils as pasture or hayland also is effective in controlling erosion. Maintaining an adequate vegetative cover and ground mulch helps to reduce runoff, thus preventing excessive soil loss and improving the moisture supply. Stocking at the proper rate, rotating grazing, controlling weeds, and deferring grazing help to keep pasture in good condition.

These soils are well suited to use as sites for windbreaks and environmental plantings. All climatically adapted trees and shrubs grow well if the competing vegetation is controlled. Competing vegetation can be controlled through good site preparation, cultivation, and the use of herbicides. Planting trees on the contour helps to conserve moisture and control erosion on these moderately sloping soils.

The Lismore soil is poorly suited to building site development because it is subject to flooding and seasonal wetness. If the Vienna soil is used as a site for buildings, foundations and footings should be reinforced to help prevent structural damage caused by the shrinking and swelling of the soil. Local roads should be constructed on raised and well compacted material to help prevent road damage resulting from frost action and the low strength of these soils. Mulching and seeding adapted grasses help to control roadside erosion and gully erosion in borrow areas. The Lismore soil is poorly suited to use as septic tank absorption fields because it is subject to flooding and seasonal wetness. If the Vienna soil is used as septic tank absorption fields, the absorption area needs to be enlarged because of the moderately slow permeability of this soil. The steepness of slopes is a limitation to the use of these soils as sites for sewage lagoons.

Capability unit IIIe-1; Silty range site.

Use and management of the soils

The soil survey is a detailed inventory and evaluation of the most basic resource of the survey area—the soil. It is useful in adjusting land use, including urbanization, to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in uses of the land.

While a soil survey is in progress, soil scientists, conservationists, engineers, and others keep extensive notes about the nature of the soils and about unique aspects of behavior of the soils. These notes include data on erosion, drought damage to specific crops, yield estimates, flooding, the functioning of septic tank disposal systems, and other factors affecting the productivity, potential, and limitations of the soils under various uses and management. In this way, field experience and measured data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section is useful in planning use and management of soils for crops and pasture, rangeland, and woodland, as sites for buildings, highways and other transportation systems, sanitary facilities, and parks and other recreation facilities, and for wildlife habitat. From the data presented, the potential of each soil for specified land uses can be determined, soil limitations to these land uses can be identified, and costly failures in houses and other structures, caused by unfavorable soil properties, can be avoided. A site where soil properties are favorable can be selected, or practices that will overcome the soil limitations can be planned.

Planners and others using the soil survey can evaluate the impact of specific land uses on the overall productivity of the survey area or other broad planning area and on the environment. Productivity and the environment are closely related to the nature of the soil. Plans should maintain or create a land-use pattern in harmony with the natural soil.

Contractors can find information that is useful in locating sources of sand and gravel, roadfill, and topsoil. Other information indicates the presence of bedrock, wetness, or very firm soil horizons that cause difficulty in excavation.

Health officials, highway officials, engineers, and many other specialists also can find useful information in this soil survey. The safe disposal of wastes, for example, is closely related to properties of the soil. Pavements, sidewalks, campsites, playgrounds, lawns, and trees and shrubs are influenced by the nature of the soil.

Crops and pasture

Scott Argabright, conservation agronomist, Soil Conservation Service, helped to prepare this section.

The major management concerns in the use of the soils for crops and pasture are described in this section. In addition, the crops or pasture plants best suited to the soil, including some not commonly grown in the survey area, are discussed; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are presented for each soil.

This section provides information about the overall agricultural potential of the survey area and about the management practices that are needed. The information is useful to equipment dealers, land improvement contractors, fertilizer companies, processing companies, planners, conservationists, an others. For each kind of soil, information about management is presented in the section "Soil maps for detailed planning." Planners of management systems for individual fields or farms should also consider the detailed information given in the description of each soil.

According to updated estimates based on the 1967 Conservation Needs Inventory, about 290,000 acres in the survey area was used for crops, pasture, and hayland in 1975. The soils in Grant County have good potential for increased crop production. About 53,000 acres of potentially good cropland is used as rangeland, 10,000 acres as pastureland, and 19,000 acres as native and tame hayland. In addition to this reserve capacity, food production can be increased by extending the latest crop production technology to all cropland in the county.

Soil erosion is the major hazard on about 46 percent of the cropland, hayland, and pasture in Grant County. If the slope is more than 2 percent, erosion is a hazard on Arvilla, Barnes, Egeland, Forman, Hattie, Heimdal, Peever, Sisseton, and Vienna soils.

If the surface layer is lost through water erosion or soil blowing, the natural environment is damaged in two ways. First, productivity is reduced as the surface layer is eroded and subsoil material is incorporated into the plow layer. Erosion of the surface layer is especially damaging to soils that have a clayey subsoil, for example, Peever and Hattie soils, and soils that have a thin surface layer, for example, Sisseton soils. Water erosion and soil blowing also reduce the productivity of droughty soils, such as Arvilla, Divide, Fordville, and Renshaw soils.

Second, soil erosion results in sedimentation in streams and lakes. Controlling erosion minimizes the pollution of streams and lakes by sediment and improves the quality of water for fish and wildlife, for recreation use, and for municipal use.

Erosion-control practices establish or maintain a protective surface cover, reduce runoff, and increase water infiltration. Maintaining a vegetative cover helps to control soil erosion so that the productivity of the soils is not reduced. On livestock farms, which require hay and pasture crops, including legume and grass forage crops in the cropping system provides nitrogen for crops, improves tilth, and reduces erosion on the sloping soils.

In most areas of the sloping Arvilla, Barnes, Egeland, Forman, Hattie, Heimdal, and Sisseton soils and in some areas of Peever soils, slopes are too short and irregular for the use of contour tillage or terraces. On these soils, a cropping system that provides a substantial vegetative cover is needed to control erosion. Minimizing tillage and leaving crop residue on the surface of the soil increase water infiltration and reduce runoff and the hazard of erosion. Using the no-till system of planting corn is effective in reducing erosion on sloping soils. Grassed waterways help to remove excess surface water without causing damage to the soils by erosion.

Terraces and diversions reduce the length of slopes and thus reduce runoff and erosion. Deep, well drained soils that have smooth, uniform slopes, for example, Vienna soils and some areas of Peever soils, are suitable for terraces, contouring, or contour stripcropping.

Soil blowing is a hazard on the Arvilla, Egeland, and Swenoda fine sandy loams; on the loamy and clayey Dovray, Hattie, Ludden, and Peever soils; and on soils that have a high content of lime, for example, Bearden, Buse, Divide, and Sisseton soils. The subirrigated Marysland and Vallers soils also are subject to soil blowing if they are cultivated. Soil blowing can damage these soils in a few hours if winds are strong and if the soils are dry and bare of vegetation or surface mulch. Maintaining a plant cover, crop residue, or a rough surface minimizes soil blowing on these soils. Stripcropping and establishing windbreaks of adapted trees and shrubs also are effective in reducing soil blowing. However, the poorly drained Ludden and Playmoor soils are not suited to use as sites for windbreaks, and the droughty Arvilla soils

and the limy Buse and Sisseton soils are poorly suited to windbreaks.

Information on designing an erosion-control system for each kind of soil is available at the local office of the Soil Conservation Service.

Soil drainage is the major management need on the poorly drained and very poorly drained Dovray, Flom, Ludden, Marysland, Parnell, Playmoor, Tonka, and Vallers soils. Unless they are artificially drained, these soils are so wet that crops frequently are damaged. In areas where a drainage outlet is available, open-ditch drainage helps to remove excess water. Controlling runoff from adjacent soils also helps to reduce wetness.

The moderately well drained Aastad, Brookings, LaDelle, Overly, and Svea soils are on stream terraces, flood plains, and flats and in upland swales. These soils are occasionally flooded by stream overflow or by runoff from adjacent soils. In wet years, this flooding delays tillage and planting in spring, but in most years, drainage is adequate and the additional moisture received from the flooding is beneficial to crops. Artificial drainage rarely is needed on these soils.

Soil fertility is naturally low in soils that have a high content of lime, such as Sisseton soils, and in soils that are shallow over sand and gravel, such as Arvilla and Renshaw soils. Including grasses and legumes in the cropping system helps to maintain fertility. For all soils, fertilizer should be applied on the basis of soil tests, on the need of the crop, and on the desired level of yield. The Cooperative Extension Service can help to determine the kind and amount of fertilizer to apply.

Soil tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils that have good tilth are granular and porous.

Maintaining tilth is a concern of management on the poorly drained and very poorly drained Dovray, Ludden, Parnell, Playmoor, Tonka, and Vallers soils. These soils commonly are wet in spring, and they dry slowly. They are difficult to till, and tilth deteriorates if these soils are cultivated at a high moisture content. Timely tillage at the correct moisture content is needed to maintain soil tilth. Hattie and Peever soils have a clay loam surface layer and lose tilth if they are tilled when wet. Timely tillage, grasses and legumes in the cropping system, crop residue management, and chiseling improve tilth. Most of the other soils in the survey area have a surface layer that is friable and easy to till within a wide range in moisture content.

Field crops that are suited to the soils and climate in the survey area include close-growing crops and row crops. Oats and spring wheat are the main close-growing crops. Other close-growing crops include alfalfa and flax and, to a lesser extent, barley, rye, and winter wheat. Corn is the main row crop. Soybeans and sorghum are grown on a small acreage. In dry years, much of the corn and sorghum is harvested for silage.

The deep, well drained and moderately well drained Aastad, Barnes, Brookings, Egeland, Forman, Heimdal, LaDelle, Overly, Poinsett, Rentill, Svea, Swenoda, and Vienna soils are suited to all commonly grown and climatically adapted crops. Arvilla, Fordville, and Renshaw soils have porous underlying material that restricts the root zone and the available water capacity. These soils are better suited to early-maturing, more drought-resistant small grains than to corn and alfalfa, which require a deeper root zone. Hattie and Peever soils have a clayey subsoil that retards root growth and restricts the amount of water that is released to plants. These soils are better suited to small grains and alfalfa than to row crops.

Pasture plants that are best suited to the climate and soils in the survey area include alfalfa, big bluestem, Indiangrass, intermediate wheatgrass, smooth bromegrass, and switchgrass.

Soils that have low fertility and high lime content, for example, Buse and Sisseton soils, are best suited to alfalfa, crested wheatgrass, intermediate wheatgrass, and smooth bromegrass.

On the droughty Arvilla and Renshaw soils, the choice of pasture plants is limited by a shallow root zone and low available water capacity. These soils are well suited to crested wheatgrass. Bunch-type species such as crested wheatgrass should not be planted singly on slopes of more than 6 percent because erosion is a hazard.

Divide, Estelline, and Fordville soils are underlain by sand or gravel but are somewhat less droughty than Arvilla and Renshaw soils. They are suited to alfalfa, intermediate wheatgrass, and smooth bromegrass.

If the poorly drained and very poorly drained Flom, Ludden, Marysland, Parnell, Tonka, and Vallers soils are used as pasture, only water-tolerant pasture plants, such as Garrison creeping foxtail and reed canarygrass, can be grown. If these soils are drained, they are suited to alfalfa, big bluestem, Garrison creeping foxtail, Indiangrass, intermediate wheatgrass, reed canarygrass, smooth bromegrass, and switchgrass. Dovray soils also are suited to these species. Saline soils, such as Playmoor soils, are best suited to tall wheatgrass.

Yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. Absence of an estimated yield indicates that the soil is not suited to the crop or the crop is not commonly grown on the soil.

The estimated yields were based mainly on the experience and records of farmers, conservationists, and extension agents. Results of field trials and demonstrations

and available yield data from nearby counties were also considered.

The yields were estimated assuming that the latest soil and crop management practices were used. Hay and pasture yields were estimated for the most productive varieties of grasses and legumes suited to the climate and the soil. A few farmers may be obtaining average yields higher than those shown in table 5.

The management needed to achieve the indicated yields of the various crops depends on the kind of soil and the crop. Such management provides drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate tillage practices, including time of tillage and seedbed preparation and tilling when soil moisture is favorable; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residues, barnyard manure, and green-manure crops; harvesting crops with the smallest possible loss; and timeliness of all fieldwork.

The estimated yields reflect the productive capacity of the soils for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not included because the acreage of these crops is small. The local offices of the Soil Conservation Service and the Cooperative Extension Service can provide information about the management concerns and productivity of the soils for these crops.

Capability classes and subclasses

Capability classes and subclasses show, in a general way, the suitability of soils for most kinds of field crops. The soils are classed according to their limitations when they are used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops or other crops that require special management. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for forest trees, or for engineering purposes.

In the capability system (*6*), all kinds of soil are grouped at three levels: capability class, subclass, and unit. These levels are defined in the following paragraphs. A survey area may not have soils of all classes.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and landforms have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class; they are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability unit is identified in the description of each soil map unit in the section "Soil maps for detailed planning." Capability units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-2 or IIIe-1.

Rangeland

C. M. Schumacher, range conservationist, Soil Conservation Service, helped prepare this section.

About 27 percent of Grant County is rangeland. The areas of rangeland generally are small and are scattered throughout the county. The largest areas are on the Forman and Buse soils in the western part of the county.

About half of the farm income in the county is from livestock operations. Cow-calf operations predominate. The average size of a livestock farm is about 500 acres. On many farms, the forage produced on rangeland is supplemented with crop stubble and tame pasture. In winter, the native forage commonly is supplemented with a protein concentrate or alfalfa.

On most of the rangeland in Grant County, the major management concern is controlling grazing so that the kind and amount of plants in the potential plant community are reestablished. In many areas, the native vegetation has been greatly depleted by continued excessive grazing. Many desirable tall grasses have been replaced by short grasses and weeds. As a result, the amount of forage produced may be less than half of that originally produced. If good range management based on information in this soil survey and in rangeland inventories is applied, the potential for increasing rangeland productivity in Grant County is good.

Where climate and topography are about the same, differences in the kind and amount of vegetation that rangeland can produce are related closely to the kind of soil. Effective management is based on the relationships among soils, vegetation, and water.

Table 6 shows, for each kind of soil, the name of the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the expected percentage of each species in the composition of the potential natural plant community. Soils not listed cannot support a natural plant community of predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. The following are explanations of column headings in table 6.

A *range site* is a distinctive kind of rangeland that differs from other kinds of rangeland in its ability to produce a characteristic natural plant community. Soils that produce a similar kind, amount, and proportion of range plants are grouped into range sites. For those areas where the relationship between soils and vegetation has been established, range sites can be interpreted directly from the soil map. Properties that determine the capacity of the soil to supply moisture and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production refers to the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year the amount and distribution of precipitation and the temperatures are such that growing conditions are substantially better than average; in a normal year these conditions are about average for the area; in an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight refers to the total air-dry vegetation produced per acre each year by the potential natural plant community. Vegetation that is highly palatable to livestock and vegetation that is unpalatable are included. Some of the vegetation can also be grazed extensively by wildlife.

Characteristic species of grasses, grasslike plants, forbs, and shrubs that make up most of the potential natural plant community on each soil are listed by common name. Under *Composition*, the expected proportion of each species is presented as the percentage, in air-dry weight, of the total annual production of herbaceous and woody plants. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season. Generally all of the vegetation produced is not used.

Range management requires, in addition to knowledge of the kinds of soil and the potential natural plant community, an evaluation of the present condition of the range vegetation in relation to its potential. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the maximum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Native woods and windbreaks

David Hintz, forester, Soil Conservation Service, helped prepare this section.

Approximately 4,900 acres in Grant County is in native trees and shrubs. However, the soils that support trees and shrubs are not classified as woodland soils. In Grant County, trees and shrubs grow in areas adjacent to the natural lakes and wetlands. They also grow on flood plains and breaks of the North and South Forks of the Whetstone and Yellow Bank Rivers and their tributaries.

American elm, American plum, boxelder, bur oak, common chokecherry, common hackberry, false indigo, eastern cottonwood, green ash, peachleaf willow, riverbank grape, sandbar willow, smooth sumac, Virginia creeper, western snowberry, and several species of wildrose are common on the flood plains and breaks of the principal rivers and their tributaries. These trees and shrubs also are common along the breaks and margins of the larger natural lakes and sloughs. Green ash, eastern cottonwood, peachleaf willow, and sandbar willow are common along the margins of the smaller sloughs and wetlands. Russian-olive, an introduced species, also is common in all these areas.

The woody vegetation in the survey area is used mainly for watershed protection, for recreation uses, and as wildlife food and cover.

Windbreaks are planted for the protection of the farmstead and livestock. They are also planted to help control soil blowing and snow drifting (fig. 11). Thousands of acres in the county still require the protection that windbreaks provide.

Windbreaks are established to protect livestock, buildings, and yards from wind and snow. Windbreaks also help protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broad-leaved and coniferous species provide the most protection.

Figure 11.—A single-row field windbreak in an area of Forman-Aastad loams, 1 to 6 percent slopes.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field, the interval depending on erodibility of the soil. They protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. A healthy planting stock of suitable species planted properly on a well prepared site and maintained in good condition can insure a high degree of plant survival.

Table 7 shows the height that locally grown trees and shrubs are expected to reach on various kinds of soil in 20 years. The estimates in table 7, based on measurements and observation of established plantings that have been given adequate care, can be used as a guide in planning windbreaks and screens. Additional information about planning windbreaks and screens and the planting and care of trees can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from nurserymen.

Wildlife habitat

John B. Farley, biologist, Soil Conservation Service, helped to prepare this section.

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the construction of water impoundments. The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, is inadequate, or is inaccessible, wildlife either are scarce or do not inhabit the area.

If the soils have the potential, wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by helping the natural establishment of desirable plants.

In table 8, the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in planning for parks, wildlife refuges, nature study areas, and other developments for wildlife; selecting areas that are suitable for wildlife; selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat; and determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* means that the element of wildlife habitat or the kind of habitat is easily created, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of *fair* means that the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most

places. Moderately intensive management is required for satisfactory results. A rating of *poor* means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* means that restrictions for the element of wildlife habitat are very severe, and although naturally occurring habitats can sometimes be maintained with specific management, it generally is not feasible to establish or improve habitat on these soils.

The elements of wildlife habitat are briefly described in the following paragraphs.

Grain and seed crops are seed-producing annuals used by wildlife. The major soil properties that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. Major soil properties that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are intermediate wheatgrass, smooth bromegrass, sweetclover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds, that provide food and cover for wildlife. Major soil properties that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are big bluestem, Missouri goldenrod, beggarweed, Western wheatgrass, and blue grama.

Hardwood trees are planted trees and shrubs that provide cover for wildlife and produce nuts or other fruit, buds, catkins, twigs, bark, or foliage that wildlife eat. Major soil properties that affect growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of hardwood trees are American plum, common chokecherry, green ash, Russian-olive, and silver buffaloberry.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that use wetland as habitat. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, cattail, and cordgrass and rushes, sedges, and reeds.

Shallow water areas are bodies of water that have an average depth of less than 5 feet and that are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water-control structures in marshes or streams. Major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed. Examples of shallow water areas are marshes, shallow dugouts, level ditches, and ponds.

The kinds of wildlife habitat are briefly described in the following paragraphs.

Openland habitat consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The kinds of wildlife attracted to these areas include ring-necked pheasant, meadowlark, mourning dove, robin, fox squirrel, cottontail, jackrabbit, red fox, raccoon, and whitetail deer.

Wetland habitat consists of open, marshy or swampy, shallow water areas where water-tolerant plants grow. Some of the wildlife attracted to such areas are ducks, coot geese, herons, shore birds, red-winged blackbird, muskrat, mink, and beaver.

Rangeland habitat consists of areas of wild herbaceous plants and shrubs. Wildlife attracted to rangeland include whitetail deer, red fox, meadowlark, lark bunting, and jackrabbit.

Recreation

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation uses. The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available, and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degree, for recreation use by the duration and intensity of flooding and the season when flooding occurs. Onsite assessment of height, duration, intensity, and frequency of flooding is essential in planning recreation facilities.

The degree of the limitation of the soils is expressed as slight, moderate, or severe. *Slight* means that the soil properties are generally favorable and that the limitations are minor and easily overcome. *Moderate* means that the limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can

be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table 11, and interpretations for dwellings without basements and for local roads and streets, given in table 10.

Camp areas require such site preparation as shaping and leveling for tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils for this use have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing camping sites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for use as picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that will increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones or boulders, is firm after rains, and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth of the soil over bedrock or hardpan should be enough to allow necessary grading.

Paths and trails for walking, horseback riding, bicycling, and other uses should require little or no cutting and filling. The best soils for this use are those that are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once during the annual period of use. They should have moderate slopes and have few or no stones or boulders on the surface.

Engineering

This section provides information about the use of soils for building sites, sanitary facilities, construction material, and water management. Among those who can benefit from this information are engineers, landowners, community planners, town and city managers, land developers, builders, contractors, and farmers and ranchers.

The ratings in the engineering tables are based on test data and estimated data in the "Soil properties" section. The ratings were determined jointly by soil scientists and engineers of the Soil Conservation Service using known relationships between the soil properties and the behavior of soils in various engineering uses.

Among the soil properties and site conditions identified by a soil survey and used in determining the ratings in this section were grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock that is within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure or aggregation, in-place soil density, and geologic origin of the soil material. Where pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

On the basis of information assembled about soil properties, ranges of values can be estimated for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values can be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems, and other engineering works. The ranges of values can be used to (1) select potential residential, commercial, industrial, and recreational uses; (2) make preliminary estimates pertinent to construction in a particular area; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities; (5) plan detailed onsite investigations of soils and geology; (6) find sources of gravel, sand, clay, and topsoil; (7) plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; (8) relate performance of structures already built to the properties of the kinds of soil on which they are built so that performance of similar structures on the same or a similar soil in other locations can be predicted; and (9) predict the trafficability of soils for cross-country movement of vehicles and construction equipment.

Data presented in this section are useful for land-use planning and for choosing alternative practices or general designs that will overcome unfavorable soil properties and minimize soil-related failures. Limitations to the use of these data, however, should be well understood. First, the data are generally not presented for soil material below a depth of 5 or 6 feet. Also, because of the scale of the detailed map in this soil survey, small areas of soils that differ from the dominant soil may be included in mapping. Thus, these data do not eliminate the need for onsite investigations, testing, and analysis by personnel having expertise in the specific use contemplated.

The information is presented mainly in tables. Table 10 shows, for each kind of soil, the degree and kind of limitations for building site development; table 11, for sanitary facilities; and table 13, for water management. Table 12 shows the suitability of each kind of soil as a source of construction materials.

The information in the tables, along with the soil map, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations and to construct interpretive maps for specific uses of land.

Some of the terms used in this soil survey have a special meaning in soil science. Many of these terms are defined in the Glossary.

Building site development

The degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets are indicated in table 10. A *slight* limitation indicates that soil properties generally are favorable for the specified use; any limitation is minor and easily overcome. A *moderate* limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A *severe* limitation indicates that one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils rated severe, such costly measures may not be feasible.

Shallow excavations are made for pipelines, sewerlines, communications and power transmission lines, basements, open ditches, and cemeteries. Such digging or trenching is influenced by soil wetness caused by a seasonal high water table; the texture and consistence of soils; the tendency of soils to cave in or slough; and the presence of very firm, dense soil layers, bedrock, or large stones. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 5 feet unless otherwise noted.

In the soil series descriptions, the consistence of each soil horizon is given, and the presence of very firm or extremely firm horizons, usually difficult to excavate, is indicated.

Dwellings and *small commercial buildings* referred to in table 10 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence of the structure from settling or shear failure of the foundation does not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, soil wetness, and depth to a seasonal high water table were also considered. Soil wetness and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns, and gardens. Depth to bedrock, slope, and large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious hazard.

Local roads and streets referred to in table 10 have an all-weather surface that can carry light to medium traffic all year. They consist of a subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load-supporting capacity and the stability of the soil as well as the quantity and workability of fill material available are important in design and construction of roads and streets. The classifications of the soil and the soil texture, density, shrink-swell potential, and potential frost action are indicators of the traffic supporting capacity used in making the ratings. Soil wetness, flooding, slope, depth to hard rock or very compact layers, and content of large stones affect stability and ease of excavation.

Sanitary facilities

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that affect ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 11 shows the degree and kind of limitations of each soil for such uses and for use of the soil as daily cover for landfills. It is important to observe local ordinances and regulations.

If the degree of soil limitation is expressed as *slight*, soils are generally favorable for the specified use and limitations are minor and easily overcome; if *moderate*, soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design; and if *severe*, soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive maintenance is required. Soil suitability is rated by the terms *good*, *fair*, or *poor*, which, respectively, mean about the same as the terms *slight*, *moderate*, and *severe*.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a

septic tank into the natural soil. Only the soil horizons between depths of 18 and 72 inches are evaluated for this use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect absorption of the effluent are permeability, depth to seasonal high water table, depth to bedrock, and susceptibility to flooding. Stones, boulders, and shallowness to bedrock interfere with installation. Excessive slope can cause lateral seepage and surfacing of the effluent. Also, soil erosion and soil slippage are hazards if absorption fields are installed on sloping soils.

In some soils, loose sand and gravel or fractured bedrock is less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and ground water in the area may be contaminated.

On many of the soils that have moderate or severe limitations for use as septic tank absorption fields, a system to lower the seasonal water table can be installed or the size of the absorption field can be increased so that performance is satisfactory.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons have a nearly level floor and cut slopes or embankments of compacted soil material. Aerobic lagoons generally are designed to hold sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water. Soils that are very high in content of organic matter and those that have cobbles, stones, or boulders are not suitable. Unless the soil has very slow permeability, contamination of ground water is a hazard where the seasonal high water table is above the level of the lagoon floor. In soils where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce the lagoon's capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the suitability of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soil material affect the performance of embankments.

Sanitary landfill is a method of disposing of solid waste by placing refuse in successive layers either in excavated trenches or on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil material. Landfill areas are subject to heavy vehicular traffic. Risk of polluting ground water and trafficability affect the suitability of a soil for this use. The best soils have a loamy or silty texture, have moderate to slow permeability, are deep to a seasonal water table, and are not subject to flooding. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability, which might allow noxious liquids to contaminate ground water. Soil wetness can be a limitation, because operating heavy equipment on a wet soil is difficult. Seepage into the refuse increases the risk of pollution of ground water.

Ease of excavation affects the suitability of a soil for the trench type of landfill. A suitable soil is deep to bedrock and free of large stones and boulders. If the seasonal water table is high, water will seep into trenches.

Unless otherwise stated, the limitations in table 11 apply only to the soil material within a depth of about 6 feet. If the trench is deeper, a limitation of slight or moderate may not be valid. Site investigation is needed before a site is selected.

Daily cover for landfill should be soil that is easy to excavate and spread over the compacted fill in wet and dry periods. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

The soils selected for final cover of landfills should be suitable for growing plants. Of all the horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either the area- or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

Where it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the sites should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas. These factors include slope, erodibility, and potential for plant growth.

Construction materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 12 by ratings of good, fair, or poor. The texture, thickness, and organic-matter content of each soil horizon are important factors in rating soils for use as construction materials. Each soil is evaluated to the depth observed, generally about 6 feet.

Roadfill is soil material used in embankments for roads. Soils are evaluated as a source of roadfill for low embankments, which generally are less than 6 feet high and less exacting in design than high embankments. The ratings reflect the ease of excavating and working the material and the expected performance of the material where it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about some of the soil properties that influence such performance is given in the descriptions of the soil series.

The ratings apply to the soil material between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons will be mixed during excavation and spreading.

Many soils have horizons of contrasting suitability within their profile. The estimated engineering properties in table 14 provide specific information about the nature of each horizon. This information can help determine the suitability of each horizon for roadfill.

Soils rated *good* are coarse grained. They have low shrink-swell potential and few cobbles and stones. They are at least moderately well drained and have slopes of 15 percent or less. Soils rated *fair* have a plasticity index of less than 15 and have other limiting features, such as moderate shrink-swell potential, moderately steep slopes, wetness, or many stones. If the thickness of suitable material is less than 3 feet, the entire soil is rated *poor*.

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 12 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in tables 14 and 15.

Topsoil is used in areas where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material in preparing a seedbed and by the ability of the soil material to support plantlife. Also considered is the damage that can result at the area from which the topsoil is taken.

The ease of excavation is influenced by the thickness of suitable material, wetness, slope, and amount of stones. The ability of the soil to support plantlife is determined by texture, structure, and the amount of soluble salts or toxic substances. Organic matter in the A1 or Ap horizon greatly increases the absorption and retention of moisture and nutrients. Therefore, the soil material from these horizons should be carefully preserved for later use.

Soils rated *good* have at least 16 inches of friable loamy material at their surface. They are free of stones and cobbles, are low in content of gravel, and have gentle slopes. They are low in soluble salts that can limit or prevent plant growth. They are naturally fertile or respond well to fertilizer. They are not so wet that excavation is difficult during most of the year.

Soils rated *fair* are loose sandy soils or firm loamy or clayey soils in which the suitable material is only 8 to 16 inches thick or soils that have appreciable amounts of gravel, stones, or soluble salt.

Soils rated *poor* are very sandy soils and very firm clayey soils; soils with suitable layers less than 8 inches thick; soils having large amounts of gravel, stones, or soluble salt; steep soils; and poorly drained soils.

Although a rating of *good* is not based entirely on high content of organic matter, a surface horizon is generally preferred for topsoil because of its organic-matter content. This horizon is designated as A1 or Ap in the soil series descriptions. The absorption and retention of moisture and nutrients for plant growth are greatly increased by organic matter.

Water management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 13 soil and site features that affect use are indicated for each kind of soil. This information is significant in planning, installing, and maintaining water control structures.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have a low seepage potential, which is determined by permeability and the depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage, erosion, and piping and has favorable stability, shrink-swell potential, shear strength, and compaction characteristics. Large stones and organic matter in a soil downgrade the suitability of a soil for use in embankments, dikes, and levees.

Drainage of soil is affected by such soil properties as permeability; texture; depth to bedrock, hardpan, or other layers that affect the rate of water movement; depth to the water table; slope; stability of ditchbanks; susceptibility to flooding; salinity and alkalinity; and availability of outlets for drainage.

Irrigation is affected by such features as slope, susceptibility to flooding, hazards of water erosion and soil blowing, texture, presence of salts and alkali, depth of root zone, rate of water intake at the surface, permeability of the soil below the surface layer, available water capacity, need for drainage, and depth to the water table.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to intercept runoff. They allow water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock, hardpan, or other unfavorable material; large stones; permeability; ease of establishing vegetation; and resistance to water erosion, soil blowing, soil slipping, and piping.

Grassed waterways are constructed to channel runoff to outlets at a nonerosive velocity. Features that affect the use of soils for waterways are slope, permeability,

erodibility, wetness, and suitability for permanent vegetation.

Soil properties

Extensive data about soil properties are summarized on the following pages. The two main sources of these data are the many thousands of soil borings made during the course of the survey and the laboratory analyses of selected soil samples from typical profiles.

In making soil borings during field mapping, soil scientists can identify several important soil properties. They note the seasonal soil moisture condition or the presence of free water and its depth. For each horizon in the profile, they note the thickness and color of the soil material; the texture, or amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or the natural pattern of cracks and pores in the undisturbed soil; and the consistence of the soil material in place under the existing soil moisture conditions. They record the depth of plant roots, determine the pH or reaction of the soil, and identify any free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to determine all major properties of key soils, especially properties that cannot be estimated accurately by field observation. Laboratory analyses are not conducted for all soil series in the survey area, but laboratory data for many soil series not tested are available from nearby survey areas.

The available field and laboratory data are summarized in tables. The tables give the estimated range of engineering properties, the engineering classifications, and the physical and chemical properties of each major horizon of each soil in the survey area. They also present data about pertinent soil and water features, engineering test data, and data obtained from physical and chemical laboratory analyses of soils.

Engineering properties

Table 14 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Table 14 gives information for each of these contrasting horizons in a typical profile. *Depth* to the upper and lower boundaries of each horizon is indicated. More information about the range in depth and about other properties in each horizon is given for each soil series in the section "Soil series and morphology."

Texture is described in table 14 in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified Soil Classification System (Unified) (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO) (*1*).

The *Unified* system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes—eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example, CL-ML.

The *AASHTO* system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines. At the other extreme, in group A-7, are fine-grained soils. Highly organic soils are classified in group A-8 on the basis of visual inspection.

When laboratory data are available, the A-1, A-2, and A-7 groups are further classified as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As an additional refinement, the desirability of soils as subgrade material can be indicated by a group index number. These numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested in the survey area, with group index numbers in parentheses, is given in table 17. The estimated classification, without group index numbers, is given in table 14. Also in table 14 the percentage, by weight, of rock fragments more than 3 inches in diameter is estimated for each major horizon. These estimates are determined mainly by observing volume percentage in the field and then converting that, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four sieves (U.S. standard) is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

Liquid limit and *plasticity index* indicate the effect of water on the strength and consistence of soil. These

indexes are used in both the Unified and AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior. Range in liquid limit and plasticity index are estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

In some surveys, the estimates are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount across classification boundaries (1 or 2 percent), the classification in the marginal zone is omitted.

Physical and chemical properties

Table 15 shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each major horizon, at the depths indicated, in the typical pedon of each soil. The estimates are based on field observations and on test data for these and similar soils.

Permeability is estimated on the basis of known relationships among the soil characteristics observed in the field—particularly soil structure, porosity, and gradation or texture—that influence the downward movement of water in the soil. The estimates are for vertical water movement when the soil is saturated. Not considered in the estimates is lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in planning and designing drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture, and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

Soil reaction is expressed as a range in pH values. The range in pH of each major horizon is based on many field checks. For many soils, the values have been verified by laboratory analyses. Soil reaction is important in selecting the crops, ornamental plants, or other plants to be grown; in evaluating soil amendments for fertility and stabilization; and in evaluating the corrosivity of soils.

Salinity is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of the nonirrigated soils. The salinity of individual irrigated fields is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of individual fields can differ greatly from the value given in table 15. Salinity affects the suitability of a soil for crop production, its stability when used as a construction material, and its potential to corrode metal and concrete.

Shrink-swell potential depends mainly on the amount and kind of clay in the soil. Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others the swelling was estimated on the basis of the kind and amount of clay in the soil and on measurements of similar soils. The size of the load and the magnitude of the change in soil moisture content also influence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads, and other structures unless special designs are used. A high shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

Erosion factors are used to predict the erodibility of a soil and its tolerance to erosion in relation to specific kinds of land use and treatment. The soil erodibility factor (K) is a measure of the susceptibility of the soil to erosion by water. Soils having the highest K values are the most erodible. K values range from 0.10 to 0.43. To estimate annual soil loss per acre, the K value of a soil is modified by factors representing plant cover, grade and length of slope, management practices, and climate. The soil-loss tolerance factor (T) is the maximum rate of soil erosion, whether from rainfall or soil blowing, that can occur without reducing crop production or environmental quality. The rate is expressed in tons of soil loss per acre per year.

Wind erodibility groups are made up of soils that have similar properties that affect their resistance to soil blowing if cultivated. The groups are used to predict the susceptibility of soil to blowing and the amount of soil lost as a result of blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are extremely erodible, so vegetation is difficult to establish. They are generally not suitable for crops.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible, but crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible, but crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible, but crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are

moderately erodible, but crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible, but crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible, and crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible, and crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Soil and water features

Table 16 contains information helpful in planning land uses and engineering projects that are likely to be affected by soil and water features.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are placed in one of four groups on the basis of the intake of water after the soils have been wetted and have received precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist chiefly of deep, well drained to excessively drained sands or gravels. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils that have a layer that impedes the downward movement of water or soils that have moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clay soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding is the temporary covering of soil with water from overflowing streams, with runoff from adjacent slopes, and by tides. Water standing for short periods after rains or after snow melts is not considered flooding, nor is water in swamps and marshes. Flooding is rated in general terms that describe the frequency and duration of flooding and the time of year when flooding is most likely. The ratings are based on evidence in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; and absence of distinctive soil horizons that form in soils of the area that are not subject to flooding. The ratings are also based on local information about floodwater levels in the area and the extent of flooding and on information that relates the position of each soil on the landscape to historic floods.

The generalized description of flood hazards is of value in land-use planning and provides a valid basis for land-use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table is the highest level of a saturated zone more than 6 inches thick for a continuous period of more than 2 weeks during most years. The depth to a seasonal high water table applies to undrained soils. Estimates are based mainly on the relationship between grayish colors or mottles in the soil and the depth to free water observed in many borings made during the course of the soil survey. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table, that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. Only saturated zones above a depth of 5 or 6 feet are indicated.

Information about the seasonal high water table helps in assessing the need for specially designed foundations, the need for specific kinds of drainage systems, and the need for footing drains to insure dry basements. Such information is also needed to decide whether or not construction of basements is feasible and to determine how septic tank absorption fields and other underground installations will function. Also, a seasonal high water table affects ease of excavation.

Potential frost action refers to the likelihood of damage to pavements and other structures by frost heaving and low soil strength after thawing. Frost action results from the movement of soil moisture into the freezing temperature zone in the soil, which causes ice lenses to form. Soil texture, temperature, moisture content, porosity, permeability, and content of organic matter are the most important soil properties that affect frost action. It is assumed that the soil is not covered by insulating vegetation or snow and is not artificially drained. Silty and clayey soils that have a high water table in winter are most susceptible to frost action. Well drained very gravelly or sandy soils are the least susceptible.

Risk of corrosion pertains to potential soil-induced chemical action that dissolves or weakens uncoated

steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical conductivity of the soil material. The rate of corrosion of concrete is based mainly on the sulfate content, texture, and acidity of the soil. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from corrosion. Uncoated steel intersecting soil boundaries or soil horizons is more susceptible to corrosion than an installation that is entirely within one kind of soil or within one soil horizon.

Engineering test data

The results of analyses of engineering properties of several typical soils of the survey area are given in table 17.

The data presented are for soil samples that were collected from carefully selected sites. The soil profiles sampled are typical of the series discussed in the section "Soil series and morphology." The soil samples were analyzed by the South Dakota Department of Transportation, Division of Highways.

The methods used in obtaining the data are listed by code in the next paragraph. Most of the codes, in parentheses, refer to the methods assigned by the American Association of State Highway and Transportation Officials. The codes for shrinkage and Unified classification are those assigned by the American Society for Testing and Materials.

The methods and codes are AASHTO classification (M-145-66); Unified classification (D-2487-69); mechanical analysis (T88-57); liquid limit (T89-60); plasticity index (T90-56); and moisture-density, method A (T99-57).

Classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*7*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the classification is based on the different soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In table 18, the soils of the survey area are classified according to the system. Categories of the system are discussed in the following paragraphs.

ORDER. Ten soil orders are recognized as classes in the system. The properties used to differentiate among orders are those that reflect the kind and degree of dominant soil-forming processes that have taken place. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders based primarily on properties that influence soil genesis and are important to plant growth or that are selected to reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Boroll (*Bor*, meaning cool, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of expression of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and a prefix that suggests something about the properties of the soil. An example is Haploborolls (*Hapl*, meaning simple horizons, plus *boroll*, the suborder of Mollisols that have a frigid temperature regime).

SUBGROUP. Each great group may be divided into three subgroups: the central (typic) concept of the great groups, which is not necessarily the most extensive subgroup; the intergrades, or transitional forms to other orders, suborders, or great groups; and the extragrades, which have some properties that are representative of the great groups but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Udic* identifies the subgroup that is thought to be more moist than is typical for the great group. An example is Udic Haploborolls.

FAMILY. Families are established within a subgroup on the basis of similar physical and chemical properties that affect management. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineral content, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, soil slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the soil properties used as family differentiae. An example is fine-loamy, mixed Udic Haploborolls.

SERIES. The series consists of soils that formed in a particular kind of material and have horizons that, except for texture of the surface soil or of the underlying substratum, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineral and chemical composition.

Soil series and morphology

In this section, each soil series recognized in the survey area is described in detail. The descriptions are arranged in alphabetic order by series name.

Characteristics of the soil and the material in which it formed are discussed for each series. The soil is then compared to similar soils and to nearby soils of other series. Then a pedon, a small three-dimensional area of soil that is typical of the soil series in the survey area, is described. The detailed descriptions of each soil horizon follow standards in the Soil Survey Manual (*5*). Unless otherwise noted, matrix colors described are for dry soil.

Following the pedon description is the range of important characteristics of the soil series in this survey area. Phases, or map units, of each soil series are described in the section "Soil maps for detailed planning."

Aastad series

The Aastad series consists of deep, moderately well drained soils that formed in glacial till. Permeability is moderately slow. These soils are in swales and on foot slopes on uplands. Slopes range from 0 to 6 percent.

Aastad soils are near Flom, Forman, and Svea soils. Flom soils are poorly drained and are in the lower positions on the landscape. Forman soils have an argillic horizon and a mollic epipedon that is less than 16 inches thick. They generally are in higher positions on the landscape than Aastad soils. Svea soils have less clay and more sand in the solum than Aastad soils.

Typical pedon of Aastad loam, in an area of Forman-Aastad loams, 1 to 6 percent slopes, 2,400 feet south and 189 feet east of the northwest corner of sec. 5, T. 120 N., R. 50 W.

Ap—0 to 6 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; moderate medium and fine granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

A12—6 to 11 inches; dark gray (10YR 4/1) clay loam, black (10YR 2/1) moist; weak medium and fine subangular blocky structure; hard, friable; neutral; clear wavy boundary.

A3—11 to 17 inches; dark gray (10YR 4/1) clay loam, black (10YR 2/1) moist; weak medium and coarse prismatic structure parting to moderate medium and coarse subangular blocky; hard, friable, neutral; clear wavy boundary.

B2—17 to 29 inches; grayish brown (2.5Y 5/3) clay loam, dark grayish brown (2.5Y 4/3) moist; few fine and medium distinct strong brown (7.5YR 5/8) and yellowish red (5YR 4/6) mottles, moist; moderate medium prismatic structure parting to moderate medium and fine subangular blocky; hard, firm; neutral; clear wavy boundary.

C1ca—29 to 38 inches; light yellowish brown (2.5Y 6/3) loam, light olive brown (2.5Y 5/4) moist; common fine and medium distinct gray (5Y 5/1) mottles, and prominent strong brown (7.5YR 5/8) mottles, moist; weak coarse prismatic structure; hard, friable; few fine accumulations of carbonates; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—38 to 60 inches; light yellowish brown (2.5Y 6/3) loam, light olive brown (2.5Y 5/4), moist; common fine and medium distinct gray (5Y 5/1) mottles and prominent strong brown (7.5YR 5/8) mottles, moist; massive; hard, friable; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 18 to 34 inches. The mollic epipedon is 16 to 24 inches thick.

The A horizon has value of 3 or 4, dry, and 2 or 3, moist. It is loam or clay loam and is 10 to 22 inches thick. It is neutral or mildly alkaline.

The B2 horizon has hue or 10YR or 2.5Y; value of 4 or 5, dry, and 2 to 4, moist; and chroma of 2 to 4. It is neutral or mildly alkaline. Some pedons have a B3 or B3ca horizon.

The C horizon has value of 5 to 7, dry, and 5 or 6, moist; and chroma of 2 to 4. It is loam or clay loam and is mildly alkaline or moderately alkaline.

Arvilla series

The Arvilla series consists of somewhat excessively drained soils on uplands. Arvilla soils formed in glacial outwash material. They are mainly shallow over sand and gravel. Permeability is moderately rapid in the solum and rapid in the underlying sand and gravel. Slopes range from 0 to 9 percent.

Arvilla soils commonly are near Fordville, Maddock, Renshaw, and Sioux soils. Fordville and Renshaw soils have a fine-loamy over sandy or sandy-skeletal control section. Maddock soils have a solum that is dominated by fine sand and is less than 2 percent coarse fragments. Sioux soils do not have a cambic horizon and have sand and gravel within a depth of 10 inches.

Typical pedon of Arvilla sandy loam, 2 to 6 percent slopes, 880 feet north and 186 feet east of the southwest corner of sec. 5, T. 120 N., R. 51 W.

Ap—0 to 7 inches; dark gray (10YR 4/1) sandy loam, black (10YR 2/1) moist; weak fine and medium granular structure; soft, very friable; neutral; abrupt smooth boundary.

B2—7 to 16 inches; dark grayish brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium and coarse prismatic structure parting to weak medium subangular blocky; slightly hard, very friable; neutral; abrupt wavy boundary.

IIC1—16 to 20 inches; brown (10YR 4/3) gravelly sand, dark brown (10YR 3/3) moist; single grain; loose; mildly alkaline; clear wavy boundary.

IIC2—20 to 60 inches; pale brown (10YR 6/3) sand and gravel, brown (10YR 4/3) moist; single grain; loose; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to sand and gravel are 14 to 24 inches. The mollic epipedon is 10 to 16 inches thick. Typically, the solum is sandy loam, but in some areas, it is loam or coarse sandy loam.

The A horizon has value of 3 or 4, dry, and 2 or 3, moist. It is 6 to 11 inches thick and is slightly acid or neutral.

The B2 horizon has value of 4 or 5, dry, and 3 or 4, moist; and chroma of 1 to 3. It is neutral or mildly alkaline. Some pedons have a B3 horizon.

The IIC horizon has hue or 10YR or 2.5Y; value of 4 to 6, dry, and 3 or 4, moist; and chroma of 2 or 3.

Barnes series

The Barnes series consists of deep, well drained soils that formed in glacial till. Permeability is moderate in the solum and moderately slow in the underlying material. These soils are on uplands. Slopes range from 1 to 20 percent.

Barnes soils are near Buse, Forman, and Svea soils. Buse soils have a thinner solum than Barnes soils, and they have carbonates at a lesser depth. Forman soils have an argillic horizon. Svea soils have a thicker solum than Barnes soils and are moderately well drained.

Typical pedon of Barnes loam, in an area of Barnes-Svea loams, 3 to 9 percent slopes, 1,200 feet east and 80 feet south of the northwest corner of sec. 31, T. 119 N., R. 50 W.

A1—0 to 5 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, friable; neutral; clear wavy boundary.

B2—5 to 13 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; neutral; abrupt wavy boundary.

C1ca—13 to 28 inches; grayish brown (2.5Y 5/2) loam, olive brown (2.5Y 4/4) moist; few fine prominent strong brown (7.5YR 5/8) mottles, moist; weak medium subangular blocky structure; slightly hard, friable; many fine and medium accumulations of carbonates; strong effervescence; mildly alkaline; gradual wavy boundary.

C2—28 to 60 inches; pale yellow (2.5Y 7/4) loam, olive brown (2.5Y 4/4) moist; common fine and medium prominent strong brown (7.5YR 5/8) and yellowish red (5YR 4/8) mottles, moist; massive; slightly hard, friable; common fine and medium accumulations of carbonates; strong effervescence; moderately alkaline.

The solum is 10 to 23 inches thick. The mollic epipedon typically is 8 to 12 inches thick. It ranges from 7 to 16 inches in thickness.

The A horizon has value of 3 or 4, dry, and 2 or 3, moist. It is loam, extremely stony loam, or silt loam and is 4 to 9 inches thick.

The B2 horizon has value of 4 or 5, dry, and 2 to 4, moist; and chroma of 2 to 4. It is loam or clay loam.

The C horizon has value of 5 to 7, dry, and 3 to 5, moist; and chroma of 2 to 4. It is loam or clay loam.

Bearden series

The Bearden series consists of deep, somewhat poorly drained, calcareous soils. Permeability is moderately slow or slow. These soils formed in glaciolacustrine material. They are in swales and in flat, basinlike areas on uplands. Slopes are 0 to 1 percent.

Bearden soils are near Heimdal, Poinsett, and Vallers soils. Heimdal soils are well drained and have a coarse-loamy control section. Poinsett soils are well drained. Vallers soils are poorly drained and have a fine-loamy control section.

Typical pedon of Bearden silty clay loam, 875 feet north and 120 feet west of the southeast corner of sec. 31, T. 121 N., R. 46 W.

Ap—0 to 7 inches; dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; weak fine and medium granular structure; slightly hard, friable; strong effervescence, mildly alkaline; abrupt smooth boundary.

A12ca—7 to 11 inches; dark gray (2.5Y 4/1) silty clay loam, black (2.5Y 2/1) moist; weak medium subangular blocky structure parting to weak fine and medium granular; slightly hard, friable; strong effervescence; mildly alkaline; abrupt wavy boundary.

ACca—11 to 18 inches; dark gray (10YR 4/1) and light brownish gray (10YR 6/2) silty clay loam, very dark gray (10YR 3/1) and grayish brown (10YR 5/2) moist; weak fine and medium subangular blocky structure; slightly hard, friable; violent effervescence; mildly alkaline; clear wavy boundary.

C1cacs—18 to 31 inches; light yellowish brown (2.5Y 6/3) silty clay loam, olive brown (2.5Y 4/3) moist; massive; slightly hard, friable; common fine and medium gypsum crystals; violent effervescence; mildly alkaline; clear wavy boundary.

C2—31 to 60 inches; pale yellow (2.5Y 7/4) silty clay loam, light olive brown (2.5Y 5/4) moist; many fine and medium distinct yellowish red (5YR 5/8) and strong brown (7.5YR 5/8) mottles, moist; massive; hard, firm; strong effervescence; moderately alkaline.

The mollic epipedon is 8 to 16 inches thick. The soil material is mildly alkaline or moderately alkaline throughout.

The A horizon has value of 3 or 4, dry, and 2, moist; and chroma of 1 or 2. It is silty clay loam, silt loam, or clay loam and is 6 to 12 inches thick.

The ACca horizon has hue of 10YR or 2.5Y, value of 4 to 6, dry, and 3 to 5, moist; and chroma of 1 or 2. It is silt loam or silty clay loam.

The C horizon has value of 6 or 7, dry, and 4 or 5, moist; and chroma of 2 to 4. Some pedons have sand, clay, or clay loam below a depth of 40 inches.

Brookings series

The Brookings series consists of deep, moderately well drained soils on uplands. These soils formed in silty material overlying glacial till. Permeability is moderate in the solum and moderately slow in the underlying glacial till. Slopes are 0 to 2 percent.

Brookings soils are similar to Lismore soils. They are near Vienna soils on the landscape. Lismore soils formed in a thinner mantle of loess and have a fine-loamy control section. Vienna soils have a mollic epidedon that is less than 16 inches thick.

Typical pedon of Brookings silt loam, 2,484 feet south and 150 feet east of the northwest corner of sec. 8, T. 120 N., R. 52 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silt loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, very friable; slightly acid; abrupt smooth boundary.

A12—7 to 12 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak fine and medium subangular blocky structure; slightly hard, very friable; neutral; clear wavy boundary.

B21—12 to 17 inches; gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) moist; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; neutral; clear wavy boundary.

B22—17 to 25 inches; grayish brown (2.5Y 5/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, friable; mildly alkaline; abrupt wavy boundary.

IIB3ca—25 to 33 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, friable; few fine accumulations of carbonates; strong effervescence; mildly alkaline; clear wavy boundary.

IIC1ca—33 to 52 inches; pale yellow (2.5Y 7/4) clay loam, light olive brown (2.5Y 5/4) moist; few fine medium distinct strong brown (7.5YR 5/8) and light brownish gray (2.5Y 6/2) mottles, moist; massive; hard, friable; few fine and medium accumulations of carbonates; strong effervescence; moderately alkaline; gradual wavy boundary.

IIC2—52 to 60 inches; pale yellow (2.5Y 7/4) clay loam, light olive brown (2.5Y 5/4) moist; few fine and medium distinct strong brown (7.5YR 5/8) and yellowish red (5YR 5/8) mottles, moist; massive; hard, friable; few fine accumulations of carbonates; strong effervescence; moderately alkaline.

The solum is 20 to 35 inches thick. Free carbonates are at a depth between 20 and 34 inches. The mollic epipedon is 16 to 25 inches thick. The glacial till substratum is at a depth between 20 and 40 inches.

The A horizon has value of 3 or 4, dry, and 2 or 3, moist. It is silt loam or silty clay loam and is 12 to 20 inches thick. The A horizon is slightly acid or neutral.

The B2 horizon has value of 3 to 5, dry, and 3 or 4, moist; and chroma of 1 to 4. It is silt loam or silty clay loam. Some pedons do not have a B3 horizon.

The IIC horizon has hue of 2.5Y or 10YR; value of 5 to 7, dry, and 4 or 5, moist; and chroma of 2 to 4. It is loam or clay loam and is mildly alkaline or moderately alkaline.

Buse series

The Buse series consists of deep, well drained soils on uplands. These soils formed in glacial till. Permeability is moderate in the surface layer and moderately slow in the underlying material. Slopes range from 4 to 40 percent.

Buse soils are near Aastad, Barnes, and Forman soils. Aastad and Barnes soils have a thicker solum than Buse soils, and they do not have carbonates in the upper part of the solum. Forman soils have an argillic horizon.

Typical pedon of Buse loam, in an area of Forman-Buse loams, 15 to 25 percent slopes, 600 feet south and 198 feet west of the northeast corner of sec. 25, T. 121 N., R. 51 W.

A1—0 to 7 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak fine and medium granular structure; slightly hard, very friable; mildly alkaline; clear wavy boundary.

C1ca—7 to 22 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak fine and medium subangular blocky structure; slightly hard, friable; many fine accumulations of carbonates; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—22 to 60 inches; light gray (2.5Y 7/2) clay loam, light olive brown (2.5Y 5/4) moist; common fine and medium prominent strong brown (7.5YR 5/8) and yellowish red (5YR 5/8) mottles, moist; massive; hard, firm; few medium accumulations of carbonates; strong effervescence; moderately alkaline.

The mollic epipedon is 7 to 10 inches thick. In some pedons, carbonates are in the A horizon.

The A horizon has value of 3 or 4, dry, and 2 or 3, moist. It is loam, extremely stony loam, or clay loam and is neutral or mildly alkaline. The A horizon is 5 to 10 inches thick.

The C horizon has hue of 2.5Y or 10YR; value of 5 to 7, dry, and 4 or 5, moist; and chroma of 2 to 4. It is mildly alkaline or moderately alkaline and is loam or clay loam.

Cavour series

The Cavour series consists of deep, moderately well drained soils on uplands. Cavour soils formed in glacial till. Permeability is slow or very slow. Slopes are 0 to 3 percent.

Cavour soils commonly are near Forman, Peever, and Tonka soils. Unlike Cavour soils, these soils do not have a natric horizon. Forman and Peever soils are well drained, and Tonka soils are poorly drained.

Typical pedon of Cavour loam, in an area of Peever-Cavour complex, 542 feet north and 480 feet west of the southeast corner of sec. 16, T. 121 N., R. 49 W.

A1—0 to 6 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; moderate fine and medium granular structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

A2—6 to 8 inches; gray (10YR 6/1) silt loam, very dark gray (10YR 3/1) moist; weak thin platy structure; slightly hard, very friable; slightly acid; abrupt wavy boundary.

B21t—8 to 16 inches; dark gray (10YR 4/1) clay, black (10YR 2/1) moist; moderate medium and coarse columnar structure parting to strong medium and fine blocky; weak thin light gray (10YR 6/1) caps on top of columns; extremely hard, very firm sticky and plastic; mildly alkaline; gradual wavy boundary.

B22tsa—16 to 21 inches; grayish brown (2.5Y 5/2) clay, very dark grayish brown (2.5Y 3/2) moist; moderate medium and coarse prismatic structure parting to strong medium and fine blocky; extremely hard, firm, sticky and plastic; common to many fine and medium nests of salt; moderately alkaline; clear wavy boundary.

B3cssa—21 to 27 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to moderate medium and fine blocky; very hard, firm, sticky and plastic; common to many fine and medium salt nests and gypsum crystals; strong effervescence; strongly alkaline; gradual wavy boundary.

C1cs—27 to 36 inches; light brownish gray (2.5Y 6/2) clay loam, olive brown (2.5Y 4/4) moist; common fine and medium distinct strong brown (7.5Y 5/8), yellowish red (5YR 4/8), and gray (5Y 5/1) mottles, moist; massive; hard, firm, sticky and plastic; common fine and medium gypsum crystals; strong effervescence; moderately alkaline; gradual wavy boundary.

C2cs—36 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, olive brown (2.5Y 4/4) moist; common fine and medium distinct strong brown (7.5YR 5/8), yellowish red (5YR 4/8), and gray (5Y 6/1) mottles, moist; massive; hard, firm, sticky and plastic; common fine and medium gypsum crystals; strong effervescence; moderately alkaline.

The solum is 20 to 38 inches thick. Free carbonates are at a depth between 18 and 30 inches. Accumulations of salts and gypsum are at a depth between 16 and 34 inches. The mollic epipedon is 12 to 30 inches thick.

The A1 horizon has value of 3 to 5, dry, and 2 or 3, moist. It is loam or silt loam and is 4 to 8 inches thick. The A1 horizon is slightly acid or neutral. The A2 horizon has value of 5 or 6, dry, and 3 or 4, moist; and chroma of 1 or 2.

The B2t horizon has value of 3 to 5, dry, and 2 to 4, moist; and chroma of 1 or 2. It is clay loam or clay and is neutral to moderately alkaline. The average clay content is 35 to 50 percent. Some pedons do not have nests of salts and gypsum.

The C horizon has hue of 2.5Y or 5Y; value of 5 to 7, dry, and 4 or 5, moist; and chroma of 2 to 4. It is loam or clay loam and is moderately alkaline or strongly alkaline.

Divide series

The Divide series consists of moderately well drained or somewhat poorly drained, calcareous soils. Divide soils formed in loamy sediment on glacial outwash plains. They are moderately deep over stratified sand and gravel. Permeability is moderate in the loamy sediment and rapid in the underlying sand and gravel. Slopes are 0 to 2 percent.

Divide soils commonly are near Fordville, Marysland, and Renshaw soils. Fordville soils are well drained, Renshaw soils are somewhat excessively drained, and Marysland soils are poorly drained.

Typical pedon of Divide loam, 1,700 feet east and 550 feet south of the northwest corner of sec. 32, T. 118 N., R. 50 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to weak fine and medium granular; slightly hard, very friable; slight effervescence; moderately alkaline; abrupt smooth boundary.

A12ca—7 to 19 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) and dark gray (10YR 4/1) moist; weak medium and coarse subangular blocky structure; slightly hard, very friable; strong effervescence; moderately alkaline; clear wavy boundary.

C1ca—19 to 23 inches; light brownish gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; weak medium and coarse subangular blocky structure; slightly hard, very friable; strong effervescence; moderately alkaline; clear wavy boundary.

IIC2—23 to 30 inches; grayish brown (2.5Y 5/2) loamy sand, olive brown (2.5Y 4/3) moist; common fine and medium prominent strong brown (7.5YR 5/8) and brown (7.5YR 4/4) mottles, moist; single grain; loose; slight effervescence; moderately alkaline; gradual wavy boundary.

IIC3—30 to 60 inches; light brownish gray (2.5Y 6/2) sand and gravel, light olive brown (2.5Y 5/4) moist; single grain; loose; slight effervescence; moderately alkaline.

Free carbonates are at the surface or within a depth of 10 inches. Sand and gravel are at a depth between 20 and 38 inches. The mollic epipedon is 7 to 20 inches thick.

The A horizon has hue of 10YR or 2.5Y, and value of 3 to 5, dry, and 2 to 4, moist. It is loam or silt loam and is 7 to 20 inches thick.

The Cca horizon has value of 5 or 6, dry, and 4 or 5, moist; and chroma of 2 or 3. It is loam or clay loam. The IIC horizon has value of 5 or 6, dry, and 4 or 5, moist; and chroma of 2 to 4.

Dovray series

The Dovray series consists of deep, poorly drained soils on bottom lands and glacial outwash flats. Dovray soils formed in lacustrine clay. Permeability is very slow. Slopes are 0 to 2 percent.

Dovray soils commonly are near LaDelle, Ludden, and Peever soils. LaDelle soils are moderately well drained and have less clay than Dovray soils. Ludden soils are calcareous throughout the control section. Peever soils are well drained and have an argillic horizon.

Typical pedon of Dovray silty clay, 219 feet north and 78 feet west of the southeast corner of sec. 3, T. 121 N., R. 49 W.

Ap—0 to 9 inches; very dark gray (2.5Y 3/1) silty clay, black (2.5Y 2/1) moist; moderate fine subangular blocky structure; very hard, firm, sticky and plastic; neutral; abrupt smooth boundary.

A12—9 to 21 inches; very dark gray (2.5Y 3/1) silty clay, black (2.5Y 2/1) moist; moderate fine subangular blocky structure; very hard, very firm, sticky and plastic; neutral; clear wavy boundary.

B21g—21 to 29 inches; dark gray (5Y 4/1) silty clay, black (5Y 2/1) moist; moderate medium and coarse prismatic structure parting to strong medium and coarse blocky and subangular blocky; very hard, very firm, sticky and plastic; neutral; gradual wavy boundary.

B22g—29 to 41 inches; gray (5Y 5/1) and olive gray (5Y 5/2) silty clay, dark olive gray (5Y 3/2) moist; many fine distinct yellowish brown (10YR 5/6) mottles, moist; moderate medium and coarse prismatic structure parting to strong medium and coarse blocky and subangular blocky; very hard, very firm, sticky and plastic; neutral; clear wavy boundary.

C1g—41 to 54 inches; gray (5Y 6/1) clay loam, gray (5Y 5/1) and olive gray (5Y 5/2) moist; common medium distinct strong brown (7.5YR 5/6) and dark reddish brown (5YR 2/2) mottles, moist; massive; hard, firm; common fine and medium accumulations of carbonates; strong effervescence; mildly alkaline; gradual wavy boundary.

C2g—54 to 60 inches; gray (5Y 6/1) clay loam, gray (5Y 5/1) and olive gray (5Y 5/2) moist; many medium distinct strong brown (7.5YR 5/6) and yellowish red (5YR 4/6) mottles, moist; massive; hard, firm; common fine and medium accumulations of carbonates; strong effervescence; mildly alkaline.

The solum is 28 to 50 inches thick. Free carbonates are at a depth between 20 and 45 inches. The mollic epipedon is 24 to 48 inches thick. The average clay content in the control section is between 40 and 60 percent.

The A1 horizon has hue of 10YR or 2.5Y and value of 3 or 4. It is silty clay or clay and is neutral or mildly alkaline. The A1 horizon is 18 to 30 inches thick.

The B2g horizon has hue of 2.5Y or 5Y; value of 4 to 6, dry, and 3 or 4, moist; and chroma of 1 or 2. It is silty clay or clay and is neutral or mildly alkaline.

The C horizon has hue of 2.5Y or 5Y; value of 5 or 6, dry, and 4 or 5, moist; and chroma of 1 or 2. It is mildly alkaline or moderately alkaline.

Egeland series

The Egeland series consists of deep, well drained soils on uplands. Egeland soils formed in glacial outwash sediment. Permeability is moderately rapid. Slopes range from 0 to 6 percent.

Egeland soils commonly are near Heimdal, Maddock, Peever, and Swenoda soils. Heimdal soils have more silt and clay throughout the control section than Egeland soils. Maddock soils are sandy. Peever soils have a fine control section; they formed in glacial till. Swenoda soils have a mollic epipedon that is more than 16 inches thick; they have contrasting IIC horizons at a depth of 22 to 36 inches.

Typical pedon of Egeland sandy loam, 2 to 6 percent slopes, 1,140 feet east and 114 feet south of the northwest corner of sec. 14, T. 119 N., R. 49 W.

Ap—0 to 8 inches; dark gray (10YR 4/1) sandy loam, black (10YR 2/1) moist; weak fine and medium

granular structure; slightly hard, very friable; few fine roots; neutral; abrupt smooth boundary.

B21—8 to 13 inches; dark brown (10YR 4/3) sandy loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; slightly hard, very friable; few fine roots; neutral; clear smooth boundary.

B22—13 to 30 inches; yellowish brown (10YR 5/4) sandy loam, dark yellowish brown (10YR 4/4) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; slightly hard, very friable; few fine roots; neutral; clear smooth boundary.

B3—30 to 35 inches; light yellowish brown (10YR 6/4) loamy sand, yellowish brown (10YR 5/4) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; soft, very friable; neutral; abrupt wavy boundary.

C1ca—35 to 48 inches; pale brown (10YR 6/3) loamy fine sand, yellowish brown (10YR 5/4) moist; single grain; soft, very friable; common fine accumulations of carbonates; strong effervescence; mildly alkaline; gradual wavy boundary.

C2—48 to 60 inches; pale brown (10YR 6/3) loamy fine sand, yellowish brown (10YR 5/4) moist; single grain; soft, very friable; few fine accumulations of carbonates; strong effervescence; mildly alkaline.

The thickness of the solum and depth to free carbonates typically are about 35 inches; they range from 18 to 40 inches. The mollic epipedon is 8 to 16 inches thick.

The A horizon has value of 3 or 4, dry, and 2 or 3, moist. It is fine sandy loam, sandy loam, or loam and is slightly acid or neutral. The A horizon is 6 to 10 inches thick.

The B2 horizon has hue of 10YR or 2.5Y; value of 4 or 5, dry, and 3 or 4, moist; and chroma of 2 to 4. It is sandy loam or fine sandy loam and is slightly acid to mildly alkaline.

The C horizon has hue of 10YR or 2.5Y; value of 5 to 7, dry, and 4 or 5, moist; chroma of 2 to 4. In some pedons, loamy glacial till is below a depth of 40 inches.

Estelline series

The Estelline series consists of well drained soils on terraces and glacial outwash plains. Estelline soils formed in a silty mantle that is moderately deep over stratified sand and gravel. Permeability is moderate in the silty mantle and rapid in the underlying sand and gravel. Slopes are 0 to 2 percent.

Estelline soils commonly are near Fordville, Heimdal, and Renshaw soils. Fordville and Renshaw soils have a fine-loamy over sandy or sandy-skeletal control section. Heimdal soils have a coarse-loamy control section.

Typical pedon of Estelline silty clay loam, 1,380 feet south and 1,295 feet west of the northeast corner of sec. 19, T. 121 N., R. 46 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; moderate fine and medium granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

B21—8 to 14 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; moderate medium and coarse prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, friable; neutral; clear wavy boundary.

B22—14 to 24 inches; brown (10YR 4/3) silty clay loam, dark brown (10YR 3/3) moist; moderate medium and coarse prismatic structure parting to moderate fine and medium subangular blocky; hard, friable; neutral; abrupt wavy boundary.

IIC—24 to 60 inches; brown (10YR 5/3) sand and gravel, dark brown (10YR 4/3) moist; yellowish red (5YR 4/6) mottles, moist; single grain; loose; slight effervescence; mildly alkaline.

The solum is 22 to 36 inches. Free carbonates are at a depth between 22 and 30 inches. The mollic epipedon is 16 to 24 inches thick. Sand and gravel are at a depth between 22 and 40 inches.

The A horizon has value of 3 or 4, dry, and 2 or 3, moist. It is silty clay loam or silt loam and is slightly acid or neutral.

The B2 horizon has hue of 10YR or 2.5Y; value of 3 to 5, dry, and 2 to 4, moist; and chroma of 1 to 3. It is silty clay loam or silt loam. Some pedons have a B3ca horizon and a C1ca horizon.

The IIC horizon has hue of 10YR or 2.5Y; value of 5 or 6, dry, and 4 or 5, moist; and chroma of 2 to 4.

Flom series

The Flom series consists of deep, poorly drained soils that formed in glacial till or in local alluvium that derived from the till. Permeability is moderately slow. These soils are along drainageways and in swales on uplands. Slopes are 0 to 1 percent.

Flom soils are near Aastad, Forman, and Buse soils. Aastad soils are moderately well drained. Forman soils are well drained and have an argillic horizon. Buse soils are well drained and have carbonates in the upper part of the solum; they have a thinner solum than Flom soils.

Typical pedon of Flom clay loam, in an area of Aastad-Flom complex, 2,128 feet east and 530 feet south of the northwest corner of sec. 29, T. 119 N., R. 47 W.

Ap—0 to 9 inches; very dark gray (N 3/0) clay loam, black (N 2/0) moist; weak fine granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

A3g—9 to 17 inches; dark gray (N 4/0) clay loam, very dark gray (N 3/0) moist; few olive gray (5Y 4/2) worm casts; moderate fine and medium subangular blocky structure; slightly hard, friable; neutral; clear wavy boundary.

B2g—17 to 25 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; few fine distinct olive brown (2.5Y 4/4) mottles, moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, friable; few fine nests of gypsum; few fine accumulations of carbonates; slight effervescence; mildly alkaline; clear wavy boundary.

C1g—25 to 29 inches; olive gray (5Y 5/2) clay loam, olive (5Y 4/3) moist; common fine distinct olive brown (2.5Y 4/4) mottles, moist; weak medium subangular blocky structure; hard, friable; few fine nests of gypsum; few medium accumulations of carbonates; slight effervescence; moderately alkaline; gradual wavy boundary.

C2gca—29 to 38 inches; light olive gray (5Y 6/2) clay loam, olive (5Y 5/3) moist; many fine and medium prominent yellowish red (5YR 5/8) mottles and distinct gray (5Y 5/1) mottles, moist; massive; hard, friable; common fine and medium nests of gypsum; common fine and medium accumulations of carbonates; strong effervescence; moderately alkaline; gradual wavy boundary.

C3g—38 to 60 inches; light olive gray (5Y 6/2) clay loam, olive (5Y 5/3) moist; many fine and medium prominent yellowish red (5YR 5/8 and 4/6) mottles and distinct gray (5Y 5/1) mottles, moist; massive; hard, friable; common fine and medium nests of gypsum; strong effervescence; mildly alkaline.

The solum typically is 20 to 28 inches thick; it ranges from 18 to 36 inches in thickness. The mollic epipedon is 14 to 20 inches thick.

The A horizon is neutral or has hue of 5Y; value of 3 or 4, dry, and 2 or 3, moist; and chroma of 1. It is loam or clay loam and is 12 to 20 inches thick.

The B2 horizon has hue of 2.5Y or 5Y; value of 5 or 6, dry, and 4 or 5, moist; and chroma of 1 or 2. It is loam or clay loam and is mildly alkaline or moderately alkaline.

The C horizon has hue of 2.5Y or 5Y; value of 6 or 7, dry, and 4 or 5, moist; and chroma of 2 or 3. It is mildly alkaline or moderately alkaline and is loam or clay loam.

Fordville series

The Fordville series consists of well drained soils that formed in loamy alluvium. Fordville soils are moderately deep over stratified sand and gravel. Permeability is moderate in the loamy alluvium and rapid in the underlying sand and gravel. These soils are on glacial outwash plains and stream terraces. Slopes range from 0 to 6 percent.

Fordville soils commonly are near Arvilla, Divide, Renshaw, and Sioux soils. Arvilla soils are sandy. Divide soils have a calcic horizon within a depth of 16 inches. Renshaw soils have sand and gravel within a depth of 20 inches and have a mollic epipedon that is less than 16 inches thick. Sioux soils have sand and gravel within a depth of 14 inches.

Typical pedon of Fordville loam, 0 to 2 percent slopes, 630 feet west and 300 feet south of the northeast corner of sec. 31, T 118 N., R. 50 W.

Ap—0 to 7 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak fine and medium granular structure; slightly hard, very friable; slightly acid; abrupt smooth boundary.

B21—7 to 13 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; moderate medium prismatic structure parting to weak medium and coarse subangular blocky; slightly hard, very friable; neutral; clear wavy boundary.

B22—13 to 17 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to weak medium and coarse subangular blocky; slightly hard, very friable; neutral; clear wavy boundary.

B3—17 to 24 inches; light olive brown (2.5Y 5/3) loam, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to weak medium and coarse subangular blocky; slightly hard, very friable; neutral; abrupt wavy boundary.

IIC1ca—24 to 28 inches; grayish brown (10YR 5/2) sand and gravel; single grain; loose; slight effervescence; mildly alkaline; gradual wavy boundary.

IIC2—28 to 60 inches; light brownish gray (2.5Y 6/2) sand and gravel, grayish brown (2.5Y 5/2) moist; single grain; loose; slight effervescence; mildly alkaline.

The mollic epipedon is 16 to 26 inches thick. Sand and gravel are at a depth of 20 to 40 inches.

The A horizon has value of 3 or 4, dry, and 2 or 3, moist. It is 6 to 9 inches thick. The A horizon is loam or silt loam and is slightly acid or neutral.

The B2 horizon has value of 3 to 5, dry, and 2 to 4, moist; and chroma of 1 to 3. It is loam or clay loam and is neutral or mildly alkaline.

The IIC horizon has value of 5 to 7, dry, and 4 to 6, moist; and chroma of 2 to 4.

Forman series

The Forman series consists of deep, well drained soils that formed in glacial till. Permeability is moderate in the solum and moderately slow in the underlying material. These soils are on uplands. Slopes range from 0 to 25 percent.

Forman soils commonly are near Aastad, Barnes, Buse, and Peever soils. Aastad soils have a mollic epipedon that is more than 16 inches thick. Barnes soils do not have an argillic horizon. Buse soils have a thinner solum than Forman soils and do not have an argillic horizon. Peever soils have a finer textured subsoil.

Typical pedon of Forman loam, in an area of Forman-Aastad loams, 1 to 6 percent slopes, 2,370 feet south and 81 feet east of the northwest corner of sec. 5, T. 120 N., R. 50 W.

Ap—0 to 6 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak fine and medium granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

B2t—6 to 16 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium and fine subangular blocky; hard, friable; neutral; abrupt wavy boundary.

B3ca—16 to 23 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; few fine and medium distinct red (2.5YR 4/8) and gray (5Y 5/1) mottles, moist; weak coarse prismatic structure parting to moderate medium and coarse subangular blocky; hard, friable; common fine and medium carbonate accumulations; strong effervescence; mildly alkaline; clear wavy boundary.

C1ca—23 to 34 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; common fine and medium strong brown (7.5YR 5/8) and red (2.5YR 4/8) mottles, moist; massive; hard, firm; common fine and medium carbonate accumulations; strong effervescence; mildly alkaline; gradual wavy boundary.

C2—34 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; common fine and medium distinct strong brown (7.5YR 5/8) and red (2.5YR 4/8) mottles, moist; massive; hard, firm; strong effervescence; moderately alkaline.

The solum is 14 to 26 inches thick. Carbonates are at a depth between 10 and 24 inches. The mollic epipedon is 12 to 16 inches thick.

The A horizon has value of 3 or 4. It is loam, extremely stony loam, or clay loam and is 4 to 8 inches thick.

The B2t horizon has hue of 10YR or 2.5Y; value of 4 or 5, dry, and 3 or 4 moist; and chroma of 2 or 3. The average clay content is 30 to 35 percent. The B2t horizon is neutral or mildly alkaline.

The C horizon has value of 6 or 7, dry, and 4 or 5, moist; and chroma of 2 through 4. It is loam or clay loam.

Hattie series

The Hattie series consists of deep, well drained soils on uplands. Hattie soils formed in clayey glacial till. Permeability is slow. Slopes range from 9 to 40 percent.

Hattie soils commonly are near Aastad, Buse, Forman, and Peever soils. Aastad soils have a mollic epipedon that is more than 16 inches thick. Buse soils have a fine-loamy control section. Forman soils have an argillic horizon and have a fine-loamy control section. Peever soils have an argillic horizon.

Typical pedon of Hattie clay loam, 9 to 15 percent slopes, 3,379 feet south and 90 feet east of the northwest corner of sec. 4, T. 120 N., R. 50 W.

Ap—0 to 7 inches; dark gray (10YR 4/1) clay loam, black (10YR 2/1) moist; moderate fine and medium granular structure; slightly hard, friable, sticky; strong effervescence; mildly alkaline; abrupt smooth boundary.

B21ca—7 to 18 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; very dark grayish brown (10YR 3/2) coatings on faces of peds; few fine and medium prominent yellowish red (5YR 4/6) and strong brown (7.5YR 5/6) mottles, moist; weak medium and coarse prismatic structure parting to moderate fine and medium subangular blocky; hard, firm, sticky; few medium accumulations of carbonates; strong effervescence; moderately alkaline; clear wavy boundary.

B22ca—18 to 30 inches; light brownish gray (2.5Y 6/2) clay, olive brown (2.5Y 4/4) moist; dark grayish brown (2.5Y 4/2) coatings on faces of peds; common fine and medium prominent yellowish red (5YR 4/6) and strong brown (7.5YR 5/8) mottles, moist; moderate medium and coarse prismatic structure parting to moderate fine and medium angular and subangular blocky; hard, firm, sticky; common fine and medium accumulations of carbonates; strong effervescence; mildly alkaline; gradual wavy boundary.

B3ca—30 to 36 inches; light brownish gray (2.5Y 6/2) clay, olive brown (2.5Y 4/4) moist; dark grayish brown (2.5Y 4/2) coatings on faces of peds; common fine and medium prominent yellowish red (5YR 5/8) mottles, moist; weak medium and coarse prismatic structure parting to moderate fine and medium angular and subangular blocky; very hard, firm, sticky; strong effervescence; moderately alkaline; gradual wavy boundary.

C—36 to 60 inches; light brownish gray (2.5Y 6/2) clay, olive brown (2.5Y 4/4) moist; common fine and medium prominent yellowish red (5YR 5/8) and strong brown (7.5YR 5/8) mottles, moist; massive; very hard, firm, sticky; strong effervescence; moderately alkaline.

The mollic epipedon is 7 to 16 inches thick. Free carbonates are throughout the pedon. The soil material is mildly alkaline or moderately alkaline throughout.

The A horizon has hue of 10YR or 2.5Y and value of 3 or 4, dry, and 2 or 3, moist. It is 5 to 12 inches thick and is clay loam, clay, or silty clay.

The B2 horizon has value of 4 to 6, dry, and 4 or 5, moist; and chroma of 2 to 4. It is clay or silty clay. Some pedons do not have a B3 horizon.

The C horizon has value of 5 or 6, dry, and 4 or 5, moist; and chroma of 2 to 4.

Heimdal series

The Heimdal series consists of deep, well drained soils on uplands. Heimdal soils formed in loamy glacial drift. Permeability is moderate. Slopes range from 0 to 15 percent.

Heimdal soils commonly are near Parnell, Sisseton, Svea, and Tonka soils. Parnell soils are very poorly drained. Sisseton soils do not have a mollic epipedon. Svea soils are moderately well drained and have a mollic epipedon that is more than 16 inches thick. Tonka soils are poorly drained.

Typical pedon of Heimdal loam, in an area of Heimdal-Sisseton loams, 2 to 6 percent slopes, 2,583 feet east and 165 feet south of the northwest corner of sec. 17, T. 121 N., R. 47 W.

Ap—0 to 8 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak fine and medium granular structure; slightly hard, very friable; neutral; abrupt smooth boundary.

B21—8 to 12 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak medium and coarse subangular blocky; slightly hard, very friable; mildly alkaline; clear wavy boundary.

B22—12 to 22 inches; brown (10YR 5/3) loam, brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak medium and coarse subangular blocky; slightly hard, very friable; mildly alkaline; abrupt wavy boundary.

C1ca—22 to 33 inches; light gray (2.5Y 7/2) loam, light olive brown (2.5Y 5/4) moist; massive; slightly hard, very friable; violent effervescence; moderately alkaline; gradual wavy boundary.

C2—33 to 60 inches; pale yellow (2.5YR 7/4) loam, light olive brown (2.5Y 5/4) moist; few fine distinct strong brown (7.5YR 5/8) mottles, moist; massive; slightly hard, very friable; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates are 12 to 25 inches. The mollic epipedon is 7 to 16 inches thick.

The A horizon has value of 3 or 4, dry, and 2 or 3, moist. It is loam or sandy loam and is 6 to 9 inches thick. The A horizon is neutral or mildly alkaline.

The B2 horizon has value of 4 to 6, dry, and 2 to 4, moist; and chroma of 2 to 4. Some pedons have a B3 horizon.

The C horizon has value of 6 to 7, dry, and 4 or 5, moist; and chroma of 2 to 4. Thin layers of sandy loam are in some pedons.

LaDelle series

The LaDelle series consists of deep, moderately well drained soils that formed in silty alluvial sediment. LaDelle soils are on stream terraces and flood plains adjacent to major streams and their tributaries. Permeability is moderate. Slopes are 0 to 2 percent.

LaDelle soils commonly are near Dovray, Forman, Peever, and Playmoor soils. Dovray soils have a finer textured control section. Forman and Peever soils are well drained and are on adjacent uplands. Playmoor soils are poorly drained and have visible salts.

Typical pedon of LaDelle silt loam, 2,052 feet south and 180 feet west of the northeast corner of sec. 20, T. 121 N., R. 47 W.

Ap—0 to 6 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak fine and medium granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

A12—6 to 18 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak fine and medium subangular blocky structure parting to weak fine and medium granular; slightly hard, friable; slight effervescence; neutral; clear wavy boundary.

C1—18 to 36 inches; gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) moist; few fine faint dark brown (10YR 3/3) mottles, moist; moderate fine and medium subangular blocky structure; slightly hard, friable; few fine salt crystals; few fine accumulations of carbonates; strong effervescence; mildly alkaline; clear wavy boundary.

C2—36 to 60 inches; gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) moist; common fine distinct dark yellowish brown (10YR 3/4) mottles, moist; massive; slightly hard, friable; common fine and medium accumulations of carbonates; strong effervescence; mildly alkaline.

The mollic epipedon is 16 to 30 inches thick. Free carbonates are at the surface or within a depth of 20 inches. In some pedons, a buried A horizon is below a depth of 20 inches.

The A horizon has value of 3 or 4, dry, and 2 or 3, moist. It is silt loam or silty clay loam and is 16 to 22 inches thick. The A horizon is neutral or mildly alkaline. Some pedons have a B horizon.

The C horizon has hue of 10YR or 2.5Y; value of 4 to 7, dry, and 2 to 5, moist; and chroma of 1 to 3. It is silt loam or silty clay loam and is mildly alkaline or moderately alkaline.

Lismore series

The Lismore series consists of deep, moderately well drained soils on uplands. Lismore soils formed in a silty mantle and the underlying glacial till. Permeability is moderate in the upper part of the solum and moderately slow in the lower part of the solum and in the underlying material. Slopes range from 0 to 6 percent.

Lismore soils commonly are near Fordville and Vienna soils. Fordville soils have sand and gravel below a depth of 20 inches. Vienna soils have a mollic epipedon that is less than 16 inches thick.

Typical pedon of Lismore silt loam, in an area of Vienna-Lismore silt loams, 1 to 6 percent slopes, 2,456 feet north and 150 feet west of the southeast corner of sec. 27, T. 120 N., R. 52 W.

Ap—0 to 7 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak fine and medium granular structure; slightly hard, very friable; slightly acid; abrupt smooth boundary.

A12—7 to 11 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak coarse prismatic structure parting to weak medium and coarse subangular blocky; slightly hard, very friable; slightly acid; clear wavy boundary.

B21—11 to 17 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak medium and coarse prismatic structure parting to moderate fine and medium subangular blocky; hard, friable; neutral; abrupt wavy boundary.

IIB22—17 to 25 inches; brown (10YR 5/3) clay loam, very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) moist; moderate medium and coarse prismatic structure parting to moderate fine and medium subangular blocky; hard, friable; neutral; abrupt wavy boundary.

IIB3ca—25 to 29 inches; light olive brown (2.5Y 5/4) clay loam, olive brown (2.5Y 4/4) moist; weak coarse prismatic structure parting to moderate fine and medium subangular blocky; hard, friable; strong effervescence; mildly alkaline; gradual wavy boundary.

IIC1ca—29 to 36 inches; light yellowish brown (2.5Y 6/4) loam, light olive brown (2.5Y 5/4) moist; few fine distinct strong brown (7.5YR 5/8) mottles, moist; massive; hard, friable; common fine accumulations of carbonates; strong effervescence; mildly alkaline; gradual wavy boundary.

IIC2—36 to 60 inches; light yellowish brown (2.5Y 6/4) loam, light olive brown (2.5Y 5/4) moist; common fine and medium distinct strong brown (7.5YR 5/8) mottles, moist; massive; hard, friable; few fine and medium accumulations of carbonates; strong effervescence; mildly alkaline.

The solum is 22 to 38 inches thick. Free carbonates are at a depth of 20 to 32 inches. The mollic epipedon is 16 to 28 inches thick. Glacial till is within a depth of 20 inches.

The A horizon has value of 3 or 4, dry, and 2 or 3, moist. It is silt loam or silty clay loam and is 10 to 18 inches thick. The A horizon is slightly acid or neutral.

The B2 and IIB2 horizons have hue of 10YR or 2.5Y; value of 3 to 5, dry, and 2 to 4, moist; and chroma of 1 to 3. The B2 horizon is silt loam or silty clay loam, and the IIB2 horizon is loam or clay loam. They are neutral or mildly alkaline. Some pedons do not have a B2 horizon.

The C horizon has value of 5 or 6, dry, and 4 or 5, moist; and chroma of 2 to 4. It is loam or clay loam and is mildly alkaline or moderately alkaline.

Ludden series

The Ludden series consists of deep, poorly drained soils on bottom lands. Ludden soils formed in clayey alluvium. Permeability is slow. Slopes are 0 to 1 percent.

Ludden soils commonly are near Dovray, LaDelle, and Playmoor soils. Dovray soils do not have carbonates within a depth of 20 inches. LaDelle soils have less clay than Ludden soils and are moderately well drained. Playmoor soils have a fine-silty control section.

Typical pedon of Ludden silty clay, 1,100 feet west and 900 feet north of the southeast corner of sec. 33, T. 121 N., R. 48 W.

Ap—0 to 8 inches; dark gray (N 4/0) silty clay, black (N 2/0) moist; moderate medium subangular blocky structure parting to moderate medium and fine granular; hard, firm, plastic; slight effervescence; mildly alkaline; abrupt smooth boundary.

A12—8 to 27 inches; dark gray (N 4/0) silty clay, black (N 2/0) moist; moderate medium angular blocky structure; hard, firm, very plastic; few medium accumulations of carbonates; strong effervescence; mildly alkaline; clear wavy boundary.

A13—27 to 38 inches; gray (10YR 5/1) silty clay, very dark gray (2.5Y 3/1) moist; moderate medium angular blocky structure; very hard, very firm, very plastic; few medium accumulations of carbonates; slight to strong effervescence; common gypsum crystals; moderately alkaline; clear wavy boundary.

C1gca—38 to 60 inches; gray (5Y 5/1) silty clay, very dark gray (5Y 3/1) moist; massive; very hard, very firm, very plastic; many medium accumulations of carbonates; strong effervescence; moderately alkaline.

The mollic epipedon is 25 to 48 inches thick. Free carbonates are throughout the pedon.

The A horizon is neutral or has hue of 10YR or 2.5Y; value of 3 to 5, dry, and 2 or 3, moist; and chroma of 1. It is silty clay or clay and is 25 to 48 inches thick. The A horizon is mildly alkaline or moderately alkaline.

The C horizon has hue of 2.5Y or 5Y; value of 3 to 5, dry, and 2 to 4, moist. It is silty clay or clay.

Maddock series

The Maddock series consists of deep, well drained soils on uplands. Maddock soils formed in sandy material that was deposited by wind and water. Permeability is rapid. Slopes range from 6 to 25 percent.

Maddock soils commonly are near Arvilla, Egeland, and Heimdal soils. Arvilla soils have loose sand and gravel at a depth of 14 to 24 inches. Egeland soils have a coarse-loamy control section. Heimdal soils have more silt and clay than Maddock soils.

Typical pedon of Maddock loamy fine sand, 6 to 25 percent slopes, 2,376 feet north and 530 feet west of the southeast corner of sec. 34, T. 121 N., R. 47 W.

Ap—0 to 7 inches; dark gray (10YR 4/1) loamy fine sand, very dark gray (10YR 3/1) moist; weak medium and coarse granular structure; slightly hard, loose; neutral; abrupt smooth boundary.

A12—7 to 14 inches; dark gray (10YR 4/1) loamy fine sand, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure; slightly hard, loose; neutral; clear wavy boundary.

B2—14 to 24 inches; yellowish brown (10YR 5/4) loamy fine sand, dark yellowish brown (10YR 3/4) moist; weak medium and coarse subangular blocky structure; slightly hard, loose; neutral; gradual wavy boundary.

C1—24 to 46 inches; yellowish brown (10YR 5/4) loamy fine sand, dark yellowish brown (10YR 3/4) moist; weak coarse subangular blocky structure; soft, loose; neutral; clear wavy boundary.

C2—46 to 60 inches; pale brown (10YR 6/3) loamy fine sand, brown (10YR 4/3) moist; single grain; soft, loose; slight effervescence; neutral.

The mollic epipedon is 12 to 16 inches thick.

The A horizon has value of 3 or 4, dry, and 2 or 3, moist. It is 8 to 16 inches thick. Typically, the A horizon is loamy fine sand, but in the upper part of some pedons it is fine sandy loam or sandy loam. It is neutral or mildly alkaline.

The B2 horizon has value of 4 or 5, dry, and 3 or 4, moist; and chroma of 3 or 4. It is loamy fine sand and is neutral or mildly alkaline.

The C horizon has value of 5 to 7, dry, and 3 to 5, moist; and chroma of 2 to 4. In some pedons, silt loam, loam, or clay loam textures are below a depth of 40 inches.

Marysland series

The Marysland series consists of poorly drained, calcareous soils that formed in loamy sediment. Marysland soils are moderately deep over sand and gravel. Permeability is moderate in the loamy sediment and rapid in the underlying sand and gravel. These soils are on glacial outwash plains. Slopes are 0 to 2 percent.

Marysland soils commonly are near Divide, Fordville, and Renshaw soils. Divide soils are somewhat poorly drained. Fordville and Renshaw soils are well drained and somewhat excessively drained; they do not have a calcic horizon within a depth of 20 inches.

Typical pedon of Marysland loam, 74 feet east and 87 feet south of the northwest corner of sec. 33, T. 118 N., R. 50 W.

A1—0 to 7 inches; dark gray (N 4/0) loam, black (N 2/0) moist; weak medium subangular blocky structure; slightly hard, very friable; strong effervescence; mildly alkaline; clear wavy boundary.

A12ca—7 to 15 inches; gray (N 5/0) loam, black (N 2/0) moist; weak medium and coarse subangular blocky structure; slightly hard, very friable; violent effervescence; mildly alkaline; clear wavy boundary.

A13ca—15 to 25 inches; gray (N 5/0) loam, very dark gray (5Y 3/1) moist; weak medium and coarse subangular blocky structure; slightly hard, very friable; violent effervescence; mildly alkaline; clear wavy boundary.

C1g—25 to 38 inches; light gray (5Y 7/2) loam and lenses of gravelly loam, light olive gray (5Y 6/2) moist; common medium distinct strong brown (7.5YR 5/8) mottles, moist; massive; slightly hard, very friable; few threads of salts; weak effervescence; mildly alkaline; clear wavy boundary.

IIC2—38 to 60 inches; light brownish gray (2.5Y 6/2) sand and gravel, light olive brown (2.5Y 5/4) moist; common medium distinct yellowish brown (10YR 5/8) mottles, moist; single grain; loose; weak effervescence; mildly alkaline.

The mollic epipedon is 12 to 30 inches thick. Depth to sand and gravel typically is 32 to 40 inches, and it ranges from 24 to 40 inches. Free carbonates are throughout the control section.

The A horizon has hue of 2.5Y or 5Y or neutral; value of 3 to 5, dry, and 2 or 3, moist; and chroma of 1. It is 12 to 30 inches thick and is loam or clay loam. The A horizon is mildly alkaline or moderately alkaline.

The C1g horizon has hue of 2.5Y or 5Y; value of 4 to 7, dry, and 3 to 6, moist; and chroma of 2 or 3. It is loam or clay loam and is mildly alkaline or moderately alkaline.

The IIC horizon has value of 6 or 7, dry, and 5 or 6, moist; and chroma of 2 to 4.

Overly series

The Overly series consists of deep, moderately well drained soils that formed in glaciolacustrine sediment. Permeability is moderately slow. These soils are on terraces and outwash flats. Slopes are 0 to 2 percent.

Overly soils commonly are near Bearden, LaDelle, Forman, and Peever soils. Bearden soils have a calcic horizon within a depth of 16 inches. LaDelle soils have an irregular decrease in organic matter content as depth increases. Forman and Peever soils have an argillic horizon; they are well drained and are on adjacent uplands.

Typical pedon of Overly silty clay loam, 2,150 feet west and 2,200 feet north of the southeast corner of sec. 17, T. 120 N., R. 48 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak fine and medium granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

A12—7 to 12 inches; dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; moderate coarse and medium subangular blocky structure; hard, friable; neutral; clear wavy boundary.

B2—12 to 19 inches; grayish brown (2.5Y 5/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable; mildly alkaline; clear wavy boundary.

B3ca—19 to 23 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, friable; strong effervescence; moderately alkaline; gradual wavy boundary.

C1ca—23 to 36 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/3) moist; massive; hard, friable; strong effervescence; moderately alkaline; clear wavy boundary.

C2—36 to 42 inches; pale olive (5Y 6/3) silty clay loam, olive (5Y 4/3) moist; massive; hard, friable; common fine nests of gypsum; strong effervescence; moderately alkaline; gradual wavy boundary.

C3—42 to 60 inches; pale yellow (5Y 7/3) and light gray (5Y 7/2) stratified silt loam, silty clay loam, and clay loam, olive (5Y 5/3) moist; many fine and medium prominent yellowish brown (10YR 5/8) mottles and distinct gray (5Y 6/1) mottles, moist; massive; hard, friable; strong effervescence; moderately alkaline.

The solum is 16 to 33 inches thick. Free carbonates are at a depth of 17 to 24 inches. The mollic epipedon is 16 to 30 inches thick.

The A horizon has value of 3 or 4, dry, and 2 or 3, moist. It is silty clay loam, silt loam, or clay loam and is 8 to 17 inches thick. The A horizon is neutral or mildly alkaline.

The B2 horizon has hue of 10YR or 2.5Y; value of 3 or 4, dry, and 2 or 3, moist; and chroma of 1 to 3. Some pedons do not have a B3 horizon.

The C horizon has value of 6 or 7, dry, and 4 or 5, moist; and chroma of 1 to 3.

Parnell series

The Parnell series consists of deep, very poorly drained soils that formed in water-sorted sediment. Parnell soils are in depressions on uplands. Permeability is slow. Slopes are 0 to 1 percent.

Parnell soils are near Forman, Heimdal, Peever, and Vienna soils; they are similar to Tonka soils. Heimdal, Peever, and Vienna soils have a thinner solum than Parnell soils; they are well drained and are on adjacent uplands. Tonka soils have an albic horizon and are in positions on the landscape similar to those of Parnell soils.

Typical pedon of Parnell silty clay loam, 2,000 feet south and 75 feet east of the northwest corner of sec. 30, T. 121 N., R. 50 W.

O—3 inches to 0; organic mulch.

A1—0 to 11 inches; very dark gray (N 3/0) silty clay loam, black (N 2/0) moist; moderate fine granular structure; slightly hard, friable; neutral; clear wavy boundary.

B21t—11 to 16 inches; very dark gray (2.5Y 3/1) silty clay, black (2.5Y 2/1) moist; weak fine and medium subangular blocky structure; hard, firm, sticky and plastic; neutral; clear wavy boundary.

B22tg—16 to 40 inches; dark gray (2.5Y 4/1) silty clay, black (2.5Y 2/1) moist; weak coarse prismatic structure parting to moderate fine and medium subangular blocky; very hard, firm, sticky and plastic; neutral; gradual wavy boundary.

B3g—40 to 54 inches; gray (5Y 5/1) silty clay, dark olive gray (5Y 3/2) moist; few fine faint yellowish brown (10YR 5/6) mottles, moist; weak coarse prismatic structure parting to moderate fine and medium angular blocky; very hard, firm, sticky and plastic; neutral; diffuse wavy boundary.

Cg—54 to 60 inches; gray (5Y 5/1) silty clay, dark gray (5Y 4/1) moist; few fine faint yellowish brown (10YR 5/6) mottles, moist; massive; very hard, firm, sticky and plastic; slight effervescence; mildly alkaline.

The solum is 35 to 60 inches thick. Free carbonates are at a depth of 35 to 60 inches. The mollic epipedon is 28 to 60 inches thick.

The A horizon has hue of 10YR or 2.5Y or neutral, value of 3 or 4, and chroma of 1. It is silty clay or silty clay loam and is 10 to 28 inches thick.

The B2t horizon has hue of 2.5Y or 5Y; value of 3 to 5, dry, and 2 to 4, moist; and chroma of 1 or 2. It is silty clay, silty clay loam, or clay.

The C horizon has hue of 2.5Y or 5Y; value of 5 or 6, dry, and 4 or 5, moist; and chroma of 1 or 2. It is silty clay, silty clay loam, or clay loam and is mildly alkaline or moderately alkaline.

Peever series

The Peever series consists of deep, well drained soils on uplands (fig. 12). Peever soils formed in loamy glacial till. Permeability is moderately slow or slow. Slopes range from 0 to 9 percent.

Peever soils are near Cavour, Forman, and Hattie soils. Cavour soils have a natric horizon. Forman soils have a fine-loamy control section. Hattie soils do not have an argillic horizon.

Typical pedon of Peever clay loam, in an area of Peever-Cavour complex, 1,558 feet north and 89 feet east of the southwest corner of sec. 16, T. 121 N., R. 49 W.

Ap—0 to 9 inches; dark gray (10YR 4/1) clay loam, black (10YR 2/1) moist; moderate fine and medium granular structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

B21t—9 to 13 inches; dark gray (10YR 4/1) and dark grayish brown (2.5Y 4/2) clay, black (10YR 2/1) and very dark grayish brown (2.5Y 3/2) moist; moderate medium prismatic structure parting to strong fine and medium angular and subangular blocky; hard, firm, sticky and plastic; neutral; clear irregular boundary.

B22t—13 to 17 inches; dark grayish brown (2.5Y 4/2) clay, very dark grayish brown (2.5Y 3/2) moist; dark grayish brown (2.5Y 4/2) moist and crushed; common fine and medium dark gray (10YR 4/1) and black (10YR 2/1) coatings, moist, on faces of peds; moderate medium prismatic structure parting to strong fine and medium blocky; hard, firm, sticky and plastic; neutral; abrupt irregular boundary.

B23tca—17 to 31 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; common fine distinct strong brown (7.5YR 5/8) and gray (N 5/0) mottles, moist; moderate medium prismatic structure parting to moderate medium and coarse subangular blocky; hard, firm, sticky and plastic; common medium accumulations of carbonates; strong effervescence; mildly alkaline; gradual wavy boundary.

B3ca—31 to 42 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; common fine and medium distinct strong brown (7.5YR 5/8) and gray (N 5/0) mottles, moist; weak medium prismatic structure parting to moderate medium and coarse subangular blocky; hard, firm; common medium accumulations of carbonates; strong effervescence; moderately alkaline; gradual wavy boundary.

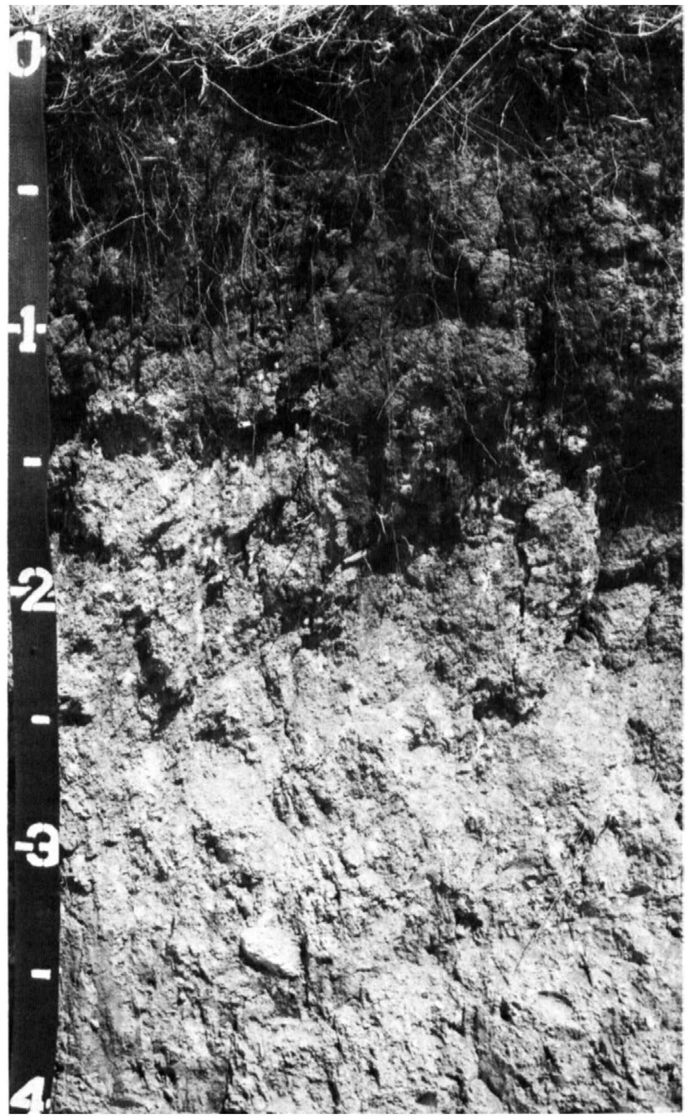


Figure 12.—Profile of Peever clay loam, 2 to 6 percent slopes. Accumulations of carbonates are at a depth of about 17 inches.

C—42 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, light olive brown (2.5Y 5/4) moist; common fine and medium distinct strong brown (7.5YR 5/8) and gray (N 5/0) mottles, moist; massive; hard, firm; strong effervescence; moderately alkaline.

The solum is 21 to 54 inches thick. Free carbonates are at a depth of 13 to 26 inches. The mollic epipedon is 7 to 16 inches thick.

The A horizon has value of 3 or 4, dry, and 2 or 3, moist. It is 6 to 10 inches thick and is slightly acid or neutral.

The B2t horizon has value of 4 to 6, dry, and 2 to 4, moist; and chroma of 1 or 2. It is clay loam or clay and is neutral or mildly alkaline. Some pedons do not have a B2tca horizon.

The C horizon has value of 5 to 7, dry, and 4 to 6, moist; and chroma of 2 to 4. It is mildly alkaline or moderately alkaline.

Playmoor series

The Playmoor series consists of deep, poorly drained, calcareous, saline soils on flood plains. Playmoor soils formed in silty and clayey alluvium. Permeability is moderately slow. Slopes are 0 to 2 percent.

Playmoor soils commonly are near Dovray, LaDelle, Ludden, and Rauville soils. Dorvay soils have a finer textured control section, and they have carbonates at a greater depth than Playmoor soils. LaDelle soils do not have concentrations of salts in the upper part of the profile, and they are in higher positions on the landscape. Ludden soils have a finer textured control section. Rauville soils are very poorly drained.

Typical pedon of Playmoor silty clay loam, 384 feet west and 168 feet south of the northeast corner of sec. 12, T 119 N., R. 49 W.

A1—0 to 8 inches; very dark gray (N 3/0) silty clay loam, black (N 2/0) moist; weak fine and medium granular structure; slightly hard, friable; common fine accumulations of salt crystals; strong effervescence; moderately alkaline; clear wavy boundary.

A12sacs—8 to 18 inches; dark gray (N 4/0) silty clay loam, black (N 2/0) moist; weak medium and coarse subangular blocky structure; slightly hard, friable; common fine nests of gypsum; many fine accumulations of salt crystals; strong effervescence; moderately alkaline; clear wavy boundary.

A13cs—18 to 36 inches; gray (N 5/0) silty clay loam, very dark gray (N 3/0) moist; weak medium and coarse subangular blocky structure; slightly hard, friable; many fine nests of gypsum; common fine accumulations of carbonates; strong effervescence; mildly alkaline; gradual wavy boundary.

Cgcs—36 to 60 inches; gray (N 5/0 and 6/0) silty clay loam, very dark gray (N 3/0) moist; massive; hard, friable; many fine nests of gypsum; few fine accumulations of carbonates; strong effervescence; mildly alkaline.

The mollic epipedon is 24 to 50 inches thick. The soil material is mildly alkaline or moderately alkaline. Free carbonates are throughout the pedon. The content of exchangeable sodium is 8 to 16 percent.

The A horizon is neutral or has hue of 10YR or 2.5Y; value of 3 to 5, dry, and 2 or 3, moist; and chroma of 1. It is 24 to 50 inches thick and is silt loam or silty clay loam. Some pedons have a buried A horizon.

The Cg horizon has hue of 2.5Y or 5Y or neutral. They commonly are silt loam or silty clay loam. In some pedons, strata of sand, silt, or clay are below a depth of 40 inches.

Poinsett series

The Poinsett series consists of deep, well drained soils on uplands. Poinsett soils formed in glacial outwash sediment. Permeability is moderate. Slopes are 0 to 2 percent.

Poinsett soils commonly are near Bearden, Estelline, Heimdal, Forman, and Peever soils. Bearden soils have a calcic horizon within a depth of 16 inches. Estelline soils have sand and gravel at a depth of 20 to 40 inches. Heimdal soils have a coarse-loamy control section. Forman and Peever soils have an argillic horizon. Forman soils have a fine-loamy control section.

Typical pedon of Poinsett silt loam, 400 feet south and 81 feet west of the northeast corner of sec. 31, T. 121 N., R. 46 W.

Ap—0 to 8 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak fine and medium granular structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

B21—8 to 12 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak coarse prismatic structure parting to weak fine and medium subangular blocky; slightly hard, friable; slightly acid; clear wavy boundary.

B22—12 to 19 inches; grayish brown (2.5Y 5/2) silt loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to moderate medium and coarse subangular blocky; slightly hard, friable; neutral; clear wavy boundary.

C1ca—19 to 27 inches; light gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) moist; weak fine and medium subangular blocky structure; slightly hard, friable; common fine accumulations of carbonates; violent effervescence; mildly alkaline; gradual wavy boundary.

C2—27 to 50 inches; light yellowish brown (2.5Y 6/4) silt loam, olive brown (2.5Y 4/4) moist; massive; hard, friable; strong effervescence; mildly alkaline; clear wavy boundary.

C3—50 to 60 inches; light yellowish brown (2.5Y 6/4) loam, olive brown (2.5Y 4/4) moist; common fine and medium distinct strong brown (7.5YR 5/8) and reddish brown (5YR 4/4) mottles, moist; massive; hard, firm; strong effervescence; mildly alkaline.

The solum is 15 to 24 inches thick. The mollic epipedon is 8 to 16 inches thick.

The A horizon has value of 3 or 4, dry, and 2 or 3, moist. It is silt loam or silty clay loam and is 6 to 10 inches thick. The A horizon is slightly acid or neutral.

The B2 horizon has value of 4 to 6, dry, and 2 to 4, moist; and chroma of 1 to 3. It is silt loam or silty clay loam and is slightly acid to mildly alkaline.

The C horizon has value of 5 to 7, dry, and 4 to 6, moist; and chroma of 2 to 4. It commonly is silt loam or silty clay loam. In some pedons, it is stratified loam or sandy loam between depths of 40 and 60 inches. The C horizon is mildly alkaline or moderately alkaline.

Rauville series

The Rauville series consists of deep, very poorly drained soils that formed in calcareous silty alluvium. Permeability is moderately slow or moderate in the upper part of the profile and moderately rapid in the underlying sand and gravel. Rauville soils are on low bottom lands along streams and in deep areas. Slopes are 0 to 1 percent.

Rauville soils commonly are near Divide, Marysland, and Renshaw soils. Divide and Marysland soils have a calcic horizon, and they have sand and gravel within a depth of 40 inches. The somewhat excessively drained Renshaw soils are on uplands; they have sand and gravel within a depth of 20 inches.

Typical pedon of Rauville silty clay loam, 635 feet west and 90 feet south of the northeast corner of sec. 17, T. 120 N., R. 52 W.

A11—0 to 7 inches; gray (10YR 5/1) and dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to weak fine and medium granular; slightly hard, friable; many roots; few fine snail shell fragments; strong effervescence; moderately alkaline; clear smooth boundary.

A12g—7 to 27 inches; dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to moderate fine granular; slightly hard, friable; few fine and medium snail shell fragments; strong effervescence; moderately alkaline; gradual smooth boundary.

C1g—27 to 45 inches; gray (10YR 6/1) silty clay loam, dark gray (2.5Y 4/1) moist; massive; very hard, firm, sticky and plastic; common fine and medium snail shell fragments; strong effervescence; moderately alkaline; abrupt smooth boundary.

IIC2—45 to 60 inches; light yellowish brown (2.5Y 6/3) stratified gravel, sand, and clay loam, light olive brown (2.5Y 5/3) moist; common medium prominent yellowish brown (10YR 5/8) mottles and common medium distinct greenish gray (5G 6/1) mottles, moist; single grain and massive; loose and very hard, loose and firm; strong effervescence; moderately alkaline.

The mollic epipedon is 24 to 35 inches thick. The soil material is mildly alkaline or moderately alkaline throughout. The calcium carbonate equivalent is 20 to 50 percent.

The A horizon is neutral or has hue of 10YR or 2.5Y; value of 3 to 5, dry, and 2 or 3, moist; and chroma of 1. It is 24 to 35 inches thick and is silt loam or silty clay loam.

The Cg horizon is neutral or has hue of 10YR, 2.5Y, or 5Y; value of 5 to 7, dry, and 4 or 5, moist; and chroma of 1. Some pedons do not have a IIC horizon.

Renshaw series

The Renshaw series consists of somewhat excessively drained soils on glacial outwash plains and stream terraces. Renshaw soils formed in loamy alluvium. They are shallow over sand and gravel. Permeability is moderately rapid in the loamy alluvium and rapid in the underlying sand and gravel. Slopes range from 0 to 25 percent.

Renshaw soils commonly are near Arvilla, Divide, Fordville, and Sioux soils. Arvilla soils have a sandy control section. Divide soils have a calcic horizon within a depth of 16 inches. Fordville soils have a mollic epipedon that is more than 16 inches thick. Sioux soils have sand and gravel within a depth of 14 inches.

Typical pedon of Renshaw loam, 0 to 2 percent slopes, 330 feet west and 78 feet north of the southeast corner of sec. 3, T. 121 N., R. 52 W.

Ap—0 to 6 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, very friable; slightly acid; abrupt smooth boundary.

B21—6 to 11 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak medium prismatic structure parting to moderate medium and coarse subangular blocky; slightly hard, very friable; neutral; clear wavy boundary.

B22—11 to 18 inches; grayish brown (10YR 5/2) and brown (10YR 5/3) loam, dark grayish brown (10YR 4/2) and dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium and coarse subangular blocky; slightly hard, very friable; mildly alkaline; abrupt wavy boundary.

IIC1—18 to 23 inches; grayish brown (10YR 5/2) sand and gravel, dark grayish brown (10YR 4/2) moist; single grain; loose; strong effervescence; mildly alkaline; clear wavy boundary.

IIC2—23 to 60 inches; brown (10YR 5/3) sand and gravel, dark brown (10YR 4/3) moist; single grain; loose; strong effervescence; mildly alkaline.

The thickness of the solum and the depth to sand and gravel are 10 to 20 inches. The mollic epipedon is 10 to 16 inches thick.

The A horizon has value of 3 or 4, dry, and 2 or 3, moist. It is 4 to 8 inches thick. The A horizon is extremely stony loam or loam and is slightly acid or neutral.

The B2 horizon has value of 3 to 5, dry, and 3 or 4, moist; and chroma of 1 to 3. It is loam or gravelly loam and is neutral or mildly alkaline.

The upper part of the IIC horizon commonly has free carbonates in the form of coats on pebbles. In some pedons, it does not have free carbonates. The IIC horizon is neutral or mildly alkaline.

Rentill series

The Rentill series consists of deep, well drained soils on uplands. Rentill soils formed in loamy glaciofluvial outwash over sandy outwash and loamy glacial till. Permeability is moderate or rapid in the upper part of the profile and moderately slow in the underlying glacial till. Slopes are 0 to 2 percent.

Rentill soils commonly are near Forman, Peever, and Renshaw soils. Forman and Peever soils formed in clay loam glacial till; they have an argillic horizon. Renshaw soils do not have clayey glacial till within a depth of 40 inches.

Typical pedon of Rentill loam, 0 to 2 percent slopes, 720 feet north and 520 feet west of the southeast corner of sec. 3, T. 121 N., R. 50 W.

Ap—0 to 7 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak fine and medium granular structure; slightly hard, very friable; neutral; abrupt smooth boundary.

B2—7 to 16 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium and coarse prismatic structure parting to moderate medium and coarse subangular blocky; slightly hard, friable; neutral; abrupt wavy boundary.

IIC1—16 to 22 inches; brown (10YR 5/3) sand and gravel, dark brown (10YR 4/3) moist; single grain; loose; strong effervescence; mildly alkaline; abrupt wavy boundary.

IIIC2ca—22 to 32 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; common fine and medium prominent strong brown (7.5YR 5/8) and yellowish red (5YR 5/8) mottles and common fine distinct gray (10YR 5/1) mottles, moist; moderate coarse prismatic structure parting to moderate medium and coarse angular and subangular blocky; hard, firm, sticky and plastic; common fine accumulations of carbonates; strong effervescence; moderately alkaline; gradual wavy boundary.

IIIC3—32 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; many fine and medium prominent strong brown (7.5YR 5/8) and yellowish red (5YR 5/8) mottles and distinct gray (10YR 5/1) mottles, moist; weak very coarse prismatic structure; hard, firm, sticky and plastic; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates are 10 to 26 inches. The mollic epipedon is 8 to 16 inches thick. Glacial till is at a depth of 18 to 38 inches.

The A horizon has value of 3 or 4, dry, and 2 or 3, moist. It is 5 to 8 inches thick and is loam or fine sandy loam. The A horizon is slightly acid or neutral.

The B2 horizon has value of 4 or 5, dry, and 3 or 4 moist; and chroma of 2 or 3. It is loam or fine sandy loam and is neutral or mildly alkaline.

The IIC horizon has value of 5 or 6, dry, and 4 or 5, moist; and chroma of 2 or 3. In some pedons, it is loamy sand or gravelly loamy sand.

The IIIC horizon has value of 5 to 7, dry, and 4 to 6, moist; and chroma of 2 to 4. It is clay loam or clay.

Sioux series

The Sioux series consists of excessively drained soils that formed in loamy, sandy, and gravelly material. Sioux soils are shallow over sand and gravel. They are on outwash plains and terraces and on knolls and ridges on glacial moraines. Permeability is rapid. Slopes range from 6 to 40 percent.

Sioux soils commonly are near Divide, Fordville, Marysland, and Renshaw soils. Divide and Marysland soils have a calcic horizon within a depth of 16 inches. Fordville soils have a mollic epipedon that is more than 16 inches thick. Renshaw soils have sand and gravel at a depth of 10 to 20 inches.

Typical pedon of Sioux sandy loam, in an area of Renshaw-Sioux complex, 6 to 15 percent slopes, 2,580 feet north and 300 feet west of the southeast corner of sec. 8, T. 120 N., R. 51 W.

A1—0 to 6 inches; very dark gray (10YR 3/1) sandy loam, black (10YR 2/1) moist; weak fine granular structure; soft, very friable; neutral; clear wavy boundary.

AC—6 to 12 inches; dark grayish brown (10YR 4/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse granular structure; soft, very friable; mildly alkaline; abrupt wavy boundary.

C—12 to 60 inches; pale brown (10YR 6/3) sand and gravel, brown (10YR 5/3) moist; single grain; loose; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to sand and gravel are 6 to 14 inches. The mollic epipedon is 7 to 14 inches thick.

The A horizon has value of 3 or 4, dry, and 2 or 3, moist. It is sandy loam, extremely stony sandy loam,

loam, or gravelly loam and is 4 to 8 inches thick. The A horizon is neutral to moderately alkaline.

The AC horizon has value of 4 to 6, dry, and 3 or 4, moist; and chroma of 1 to 3. It is gravelly sandy loam, sandy loam, or gravelly loam.

The C horizon has hue of 10YR or 2.5Y; value of 5 to 7, dry, and 4 to 6, moist; and chroma of 2 to 4.

Sisseton series

The Sisseton series consists of deep, well drained soils on uplands. Sisseton soils formed in loamy glacial drift. Permeability is moderate. Slopes range from 2 to 40 percent.

Sisseton soils are near Buse, Heimdal, Svea, and Tonka soils. Buse soils have a fine-loamy control section. Heimdal and Svea soils have a thicker solum than Sisseton soils. They do not have free carbonates in the upper part of the solum. The poorly drained Tonka soils are in depressions.

Typical pedon of Sisseton loam, in an area of Sisseton-Heimdal loams, 9 to 15 percent slopes, 2,275 feet west and 108 feet north of the southeast corner of sec. 7, T. 121 N., R. 47 W.

Ap—0 to 7 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak fine granular structure; slightly hard, very friable; strong effervescence; mildly alkaline; abrupt smooth boundary.

C1ca—7 to 17 inches; light gray (2.5Y 7/2) loam, light olive brown (2.5Y 5/4) moist; few fine prominent yellowish red (5YR 4/8) mottles, moist; weak medium subangular blocky structure; slightly hard, very friable; common medium accumulations of carbonates; strong effervescence; moderately alkaline; clear wavy boundary.

C2ca—17 to 35 inches; pale yellow (2.5Y 7/3) loam, light olive brown (2.5Y 5/4) moist; common fine and medium prominent yellowish red (5YR 4/6 and 5/8) mottles, moist; weak medium subangular blocky structure; slightly hard, very friable; common medium accumulations of carbonates; strong effervescence; moderately alkaline; gradual wavy boundary.

C3—35 to 60 inches; pale yellow (2.5Y 7/4) loam, light yellowish brown (2.5Y 6/4) moist; common fine and medium prominent yellowish red (5YR 5/8) mottles, moist; massive; slightly hard, very friable; few medium accumulations of carbonates; strong effervescence; moderately alkaline.

Carbonates typically are throughout the A and C horizons. In some pedons in native grass, there are no carbonates in the upper few inches. The soil material is mildly alkaline or moderately alkaline throughout.

The A horizon has value of 5 to 7, dry, and 4 or 5, moist; and chroma of 2 to 4. It is loam or silt loam and is 4 to 8 inches thick.

The C horizon has value of 6 or 7, dry, and 4 to 6, moist; and chroma of 2 to 4. It typically is loam or silt loam. In some pedons, strata of sandy loam are in the lower part of the profile.

Svea series

The Svea series consists of deep, moderately well drained soils on uplands. Svea soils formed in glacial till. Permeability is moderate in the solum and moderately slow in the underlying material. Slopes range from 0 to 9 percent.

Svea soils commonly are near Aastad, Barnes, Heimdal, and Swenoda soils. Aastad soils have more clay than Svea soils. Barnes soils have a mollic epipedon that is less than 16 inches thick. Heimdal soils have a coarse-loamy control section, and they have a mollic epipedon that is less than 16 inches thick. Swenoda soils have a coarse-loamy control section.

Typical pedon of Svea loam, in an area of Heimdal-Svea loams, 2 to 6 percent slopes, 840 feet east and 84 feet north of the southwest corner of sec. 33, T. 121 N., R. 47 W.

Ap—0 to 7 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; moderate fine and medium granular structure; slightly hard, very friable; neutral; abrupt smooth boundary.

A12—7 to 13 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak coarse subangular blocky structure parting to moderate fine and medium granular; slightly hard, very friable; neutral; clear wavy boundary.

B21—13 to 19 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, friable; neutral; clear wavy boundary.

B22—19 to 28 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; moderate medium and coarse prismatic structure parting to moderate medium and coarse subangular blocky; slightly hard, friable; neutral; abrupt wavy boundary.

C1ca—28 to 42 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; few fine distinct strong brown (7.5YR 5/8) mottles, moist; weak medium subangular blocky structure; slightly hard, friable; common fine and medium accumulations of carbonates; strong effervescence; mildly alkaline; gradual wavy boundary.

C2—42 to 60 inches; light brownish gray (2.5Y 6/2) stratified loam and sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, friable; few

fine accumulations of carbonates; strong effervescence; mildly alkaline.

The solum is 21 to 30 inches thick. The mollic epipedon is 16 to 28 inches thick.

The A horizon has value of 3 or 4, dry, and 2 or 3, moist. It is loam or silt loam and is 10 to 20 inches thick. The A horizon is neutral or mildly alkaline.

The B2 horizon has value of 3 to 5, dry, and 2 to 4, moist; and chroma of 2 or 3. It is loam or clay loam and is neutral or mildly alkaline. A B3 horizon is in some pedons. The C horizon has value of 5 to 7, dry, and 4 or 5, moist; and chroma of 2 to 4. It is loam or clay loam. In some pedons, the C horizon has lenses of sandy loam.

Swenoda series

The Swenoda series consists of deep, moderately well drained soils on uplands. Swenoda soils formed in loamy sediment and the underlying glacial till. Permeability is moderately rapid in the upper part of the soil and moderate or moderately slow in the underlying glacial till. Slopes are 0 to 2 percent.

Swenoda soils commonly are near Egeland, Forman, Heimdal, and Peever soils. Egeland soils have a mollic epipedon that is less than 16 inches thick, and they do not have a IIC horizon. Forman soils formed in glacial till; they have an argillic horizon and a fine-loamy control section. Heimdal soils have more silt and clay throughout the control section than Swenoda soils. Peever soils have a fine control section, and they are on glacial till plains near Swenoda soils.

Typical pedon of Swenoda fine sandy loam, 0 to 2 percent slopes, 1,506 feet west and 72 feet south of the northeast corner of sec. 36, T. 118 N., R. 48 W.

Ap—0 to 7 inches; dark gray (10YR 4/1) fine sandy loam, black (10YR 2/1) moist; weak fine and medium granular structure; slightly hard, very friable; slightly acid; abrupt smooth boundary.

A12—7 to 12 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium and coarse subangular blocky structure parting to weak fine and medium granular; slightly hard, very friable; slightly acid; clear wavy boundary.

B21—12 to 17 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium and coarse prismatic structure parting to weak medium and coarse subangular blocky; slightly hard, very friable; neutral; clear wavy boundary.

B22—17 to 26 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure parting to weak medium and coarse subangular blocky; slightly hard, very friable; neutral; abrupt wavy boundary.

IIB3—26 to 32 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium and coarse prismatic structure parting to moderate fine and medium and subangular blocky; very hard, firm; neutral; clear wavy boundary.

IIC1—32 to 42 inches; light gray (2.5Y 7/2) clay loam, grayish brown (2.5Y 5/2) moist; many fine and medium prominent strong brown (7.5YR 5/8) mottles and common fine and medium distinct olive gray (5Y 5/2) mottles, moist; massive; hard, firm; common fine and medium accumulations of carbonates; strong effervescence; mildly alkaline; gradual wavy boundary.

IIC2—42 to 60 inches; light gray (2.5Y 7/2) clay loam, grayish brown (2.5Y 5/2) moist; common fine and medium prominent strong brown (7.5YR 5/6) mottles and common fine and medium distinct gray (5Y 5/1) mottles, moist; massive; hard, firm; few fine and medium accumulations of carbonates; strong effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates are 22 to 36 inches. The mollic epipedon is 16 to 32 inches thick.

The A horizon has value of 3 or 4, dry, and 2 or 3 moist; and chroma of 1 or 2. It is fine sandy loam, sandy loam, or loam and is 10 to 16 inches thick. The A horizon is slightly acid or neutral.

The B horizon has hue of 10YR or 2.5Y; value of 3 to 5, dry, and 2 to 4, moist; and chroma of 1 to 3. It is neutral or mildly alkaline. Some pedons do not have a IIB3 horizon.

The IIC horizon has hue of 2.5Y or 5Y; value of 6 or 7, dry, and 4 or 5, moist; and chroma of 2 to 4. It is loam or clay loam and is mildly alkaline or moderately alkaline.

Tonka series

The Tonka series consists of deep, poorly drained soils that formed in local alluvium and glacial till. These soils are in depressions on uplands. Permeability is slow. Slopes are 0 to 1 percent.

Tonka soils commonly are near Forman, Heimdal, and Peever soils; they are similar to Parnell soils. The well drained Forman, Heimdal, and Peever soils are on adjacent uplands; they have a thinner solum than Tonka soils. Parnell soils are in positions on the landscape similar to those of Tonka soils; they do not have an albic horizon.

Typical pedon of Tonka silt loam, in an area of Vallers-Tonka complex, 310 feet east and 112 feet north of the southwest corner of sec. 9, T. 121 N., R. 47 W.

Ap—0 to 6 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak fine granular structure;

slightly hard, friable; neutral; abrupt smooth boundary.

A12—6 to 10 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak fine and medium granular structure; slightly hard, friable; neutral; abrupt wavy boundary.

A2—10 to 23 inches; gray (10YR 6/1) silt loam, dark gray (10YR 4/1) moist; common medium distinct dark brown (10YR 3/3) mottles, moist; moderate thin platy structure; slightly hard, friable; neutral; abrupt irregular boundary.

B21t—23 to 31 inches; dark gray (5Y 4/1) silty clay, black (5Y 2/1) moist; moderate coarse prismatic structure parting to moderate fine and medium blocky; very hard, firm; slightly acid; gradual wavy boundary.

B22t—31 to 42 inches; gray (5Y 5/1) and olive gray (5Y 5/2) silty clay, dark gray (5Y 4/1) and olive gray (5Y 4/2) moist; few fine distinct strong brown (7.5YR 5/6) mottles, moist; moderate medium and coarse prismatic structure parting to moderate fine and medium blocky; very hard, firm; neutral; clear wavy boundary.

B3—42 to 50 inches; olive gray (5Y 5/2) clay loam, olive gray (5Y 4/2) moist; common fine and medium distinct strong brown (7.5YR 5/6 and 5/8) mottles, moist; weak coarse prismatic structure parting to weak and medium subangular blocky; slightly hard, friable; neutral; gradual wavy boundary.

C1—50 to 60 inches; light olive gray (5Y 6/2) clay loam, olive gray (5Y 5/2) moist; common fine and medium distinct strong brown (7.5YR 5/6 and 5/8) mottles, moist; massive; slightly hard, friable; mildly alkaline.

The thickness of the solum and the depth to free carbonates commonly are 30 to 40 inches, but they range from 25 to 60 inches.

The A1 horizon has hue of 10YR or 2.5Y or neutral; value of 4 or 5, dry, and 2 or 3, moist; and chroma of 1. It is silt loam, loam, or clay loam and is slightly acid or neutral. The A1 horizon is 6 to 18 inches thick. The A2 horizon has hue of 10YR or 2.5Y; value of 5 to 7, dry, and 3 to 5, moist; and chroma of 1 or 2. It is loam or silt loam and is 6 to 18 inches thick.

The B2 horizon has hue of 2.5Y or 5Y; value of 4 or 5, dry, and 2 or 3, moist; and chroma of 1 or 2. It is clay loam, clay, or silty clay.

The C horizon has value of 5 or 6, dry, and 4 or 5, moist; and chroma of 1 or 2. It is mildly alkaline or moderately alkaline.

Vallers series

The Vallers series consists of deep, poorly drained, calcareous soils on uplands. Vallers soils formed in glacial till. Permeability is moderately slow. Slopes are 0 to 3 percent.

Vallers soils commonly are near Forman, Heimdal, Parnell, Peever, and Vienna soils. The Forman, Heimdal, Peever, and Vienna soils are well drained and do not have a calcic horizon within a depth of 16 inches. Parnell soils are poorly drained and have more clay than Vallers soils.

Typical pedon of Vallers loam, in an area of Vallers-Parnell complex, 635 feet north and 93 feet east of the southwest corner of sec. 4, T. 120 N., R. 51 W.

A1—0 to 7 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable; strong effervescence; mildly alkaline; clear wavy boundary.

A12—7 to 15 inches; dark gray (2.5Y 4/1) loam, black (2.5Y 2/1) moist; weak medium and coarse subangular blocky structure; slightly hard, friable; strong effervescence; mildly alkaline; gradual wavy boundary.

ACca—15 to 21 inches; dark gray (5Y 4/1) loam, very dark gray (5Y 3/1) moist; few fine and medium distinct brown (7.5YR 4/1) and strong brown (7.5YR 5/6) mottles, moist; weak medium and coarse subangular blocky structure; slightly hard, friable; violent effervescence; mildly alkaline; clear wavy boundary.

C1gca—21 to 32 inches; gray (5Y 6/1) loam, olive gray (5Y 5/2) moist; common fine and medium distinct strong brown (7.5YR 5/8) and reddish yellow (7.5YR 6/8) mottles, moist; weak medium and coarse subangular blocky structure; hard, friable; violent effervescence; moderately alkaline; gradual wavy boundary.

C2g—32 to 41 inches; light gray (5Y 7/2) clay loam, light olive gray (5Y 6/2) moist; many fine and medium prominent strong brown (7.5YR 5/8) and yellowish red (5YR 5/8) mottles, moist; massive; hard, firm; strong effervescence; moderately alkaline; gradual wavy boundary.

C3—41 to 60 inches; light gray (5Y 7/2) clay loam, olive (5Y 5/3) moist; common fine and medium prominent strong brown (7.5YR 5/8) and yellowish red (5YR 5/8) mottles, moist; massive; hard, firm; strong effervescence; moderately alkaline.

The mollic epipedon is 10 to 22 inches thick. The soil material is mildly alkaline or moderately alkaline throughout.

The A horizon has hue of 10YR or 2.5Y or neutral; value of 4 or 5, dry, and 2 or 3, moist; and chroma of 1. It is loam, clay loam, or silt loam and is 10 to 18 inches thick.

The Cca horizon has hue of 2.5Y or 5Y; value of 4 to 6, dry, and 3 to 5, moist; and chroma of 1 or 2. It is loam or clay loam.

The C horizon has hue of 2.5Y or 5Y; value of 5 to 7, dry, and 4 to 6, moist; and chroma of 2 or 3.

Vienna series

The Vienna series consists of deep, well drained soils on uplands. Vienna soils formed in silty material and the underlying glacial till. Permeability is moderate in the solum and moderately slow in the underlying material. Slopes range from 0 to 15 percent.

Vienna soils commonly are near Buse, Forman, Lismore, and Renshaw soils. Buse soils generally are steeper than Vienna soils and have carbonates leached to a lesser depth. Forman soils have an argillic horizon. Lismore soils have a mollic epipedon that is more than 16 inches thick. Renshaw soils have sand and gravel within a depth of 20 inches.

Typical pedon of Vienna silt loam, in an area of Vienna-Lismore silt loams, 1 to 6 percent slopes, 2,250 feet north and 112 feet west of the southeast corner of sec. 19, T. 120 W., R. 51 N.

Ap—0 to 7 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, very friable; slightly acid; abrupt smooth boundary.

A12—7 to 10 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak medium prismatic structure parting to weak fine subangular blocky; slightly hard, very friable; neutral; clear wavy boundary.

B21—10 to 15 inches; dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) silt loam, very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) moist; weak medium and coarse prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, friable; neutral; abrupt wavy boundary.

IIB22—15 to 20 inches; grayish brown (2.5Y 5/3) clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to moderate fine and medium subangular blocky; hard, firm; mildly alkaline; abrupt wavy boundary.

IIB3ca—20 to 28 inches; light yellowish brown (2.5Y 6/4) clay loam, olive brown (2.5Y 4/4) moist; weak medium and coarse subangular blocky structure parting to moderate medium subangular blocky; hard, firm; few fine accumulations of carbonates; strong effervescence; moderately alkaline; gradual wavy boundary.

IIC1ca—28 to 36 inches; pale yellow (2.5Y 7/4) loam, light olive brown (2.5Y 5/4) moist; few fine and medium distinct reddish brown (5YR 4/3) mottles, moist; massive; hard, firm; common medium accumulations of carbonates; strong effervescence; moderately alkaline; gradual wavy boundary.

IIC2—36 to 60 inches; pale yellow (2.5Y 7/4) loam, light olive brown (2.5Y 5/4) moist; common fine and medium distinct dark reddish brown (5YR 3/4) and yellowish red (5YR 4/6) mottles, moist; massive; hard, firm; strong effervescence; moderately alkaline.

The solum is 18 to 36 inches thick. Free carbonates are at a depth of 16 to 28 inches. The mollic epipedon is 12 to 16 inches thick.

The A horizon has value or 3 or 4, dry, and 2 or 3, moist. It is silt loam or clay loam and is 7 to 12 inches thick. The A horizon is neutral or slightly acid.

The B2 horizon has value of 4 or 5, dry, and 3 or 4, moist; and chroma of 2 or 3. It is silt loam or silty clay loam. The IIB2 horizon has value of 4 or 5, dry, and 3 or 4, moist; and chroma of 3 or 4. It is clay loam or loam and is neutral or mildly alkaline.

The IIC horizon has value of 6 or 7, dry, and 5 or 6, moist; and chroma of 2 to 4. It is mildly alkaline or moderately alkaline.

Formation of the soils

In this section, the five factors of soil formation are discussed and are related to the soils in Grant County.

Factors of soil formation

Soil is produced by soil-forming processes that act on the material that is deposited or accumulated by geologic forces. The characteristics of the soil at any given place are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the processes of soil formation have acted on the soil material.

Climate and plant and animal life are the active factors in soil formation. They act on the parent material that has accumulated through the weathering of rock and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also influences soil formation and, in extreme cases, entirely determines the kind of soil that is formed. Finally, time is needed for changing the parent material into soil and for the differentiation of soil horizons. In general, a long time is required for distinct horizons to develop.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. In the following paragraphs, the factors of soil formation are briefly discussed as they relate to the soils in Grant County.

Climate

Climate affects soil formation through its direct influence on the rate of the chemical and physical weathering of parent material. Grant County has a continental climate characterized by cold winters and hot summers. This climate is favorable for a grassland ecology. In grassland, the soils have a dark colored surface layer because the grasses have added a large amount of organic matter to the soils. The precipitation in the area is sufficient to leach carbonates in most soils to a depth of 18 to 20 inches. Because the climate is relatively uniform throughout the county, it alone does not account for all the differences among the soils.

Plants and animals

All living organisms, including plants, animals, insects, earthworms, bacteria, and fungi, play an important part in soil formation. Vegetation generally influences the color of the surface layer, the amount of organic matter, and the amount of nutrients in the soil. Animals such as earthworms, cicada, and burrowing animals help to keep the soil open and porous. Bacteria and fungi decompose the vegetation, thus releasing nutrients to plants.

In Grant County, tall and mid prairie grasses have had more influence on soil formation than any other living organisms. Consequently, soils such as Aastad, Forman, Heimdal, and Peever soils have a high amount of organic matter in the surface layer. Soil reaction generally is favorable for plants.

Parent material

Most of the soils in Grant County formed in glacial material that was derived from preglacial formations of granite, gneiss, limestone, sandstone, and shale. The glacier broke off material from these formations and ground and mixed the material as it moved. When the glacier melted, the glacial material was redeposited. Some deposits consist of unsorted materials, or glacial till. The material in other deposits was sorted either by water as the material was deposited or by wind and water after it was deposited.

Glacial deposits of Late Wisconsin age, up to several hundred feet thick, cover older glacial drift. The Late Wisconsin deposits consist mainly of poorly sorted glacial till, stratified loamy glacial drift, stratified glacial outwash, and alluvial sediment. Cretaceous rock is near the surface throughout most of the county (*3*). Granite is near the surface in the eastern part of the county and crops out in a few places.

The glacial till in the east-central part of the county, below the Prairie Coteau, has weathered to olive gray clay loam or clay. It is firm and contains fragments of shale. The Cavour, Hattie, and Peever soils formed in this till. In other parts of the county, the glacial till is brownish to yellowish loam to clay loam. It is friable to firm. The Aastad, Buse, and Forman soils formed in this till.

A thin mantle of loess or silt overlies the glacial till in the nearly level to sloping upland areas in the western part of the county. Brookings, Lismore, and Vienna soils formed in this material.

A mantle of stratified loamy glacial drift overlies the glacial till throughout much of the northeastern part of the county. Heimdal and Sisseton soils formed in this stratified glacial drift.

Glacial outwash material consisting of sand, gravel, and loamy material is scattered throughout the county. This material was deposited by glacial melt water. Arvilla, Divide, Fordville, and Renshaw soils formed in loamy material underlain by sand and gravel. Swenoda soils formed in sandy outwash sediment that is underlain by glacial till at a depth of less than 40 inches. Egeland and Maddock soils are in areas where the sandy outwash sediment is more than 40 inches thick.

Parnell and Tonka soils formed partly or entirely in local alluvium that washed from adjacent upland soils. Dovray, LaDelle, Ludden, and Playmoor soils formed in alluvium that was deposited by stream overflow.

Relief

The relief, or lay of the land, affects soil formation through its influence on drainage, erosion, plant cover, and soil temperature. Buse and Sisseton soils, for example, lose a large amount of rainwater through excessive runoff. In these soils, the amount of moisture that enters the soil is reduced, and erosion is accelerated. Soils such as Buse and Sisseton soils have a thin surface horizon of organic matter accumulation and are calcareous at or near the surface. Runoff is less rapid on the Heimdal, Forman, and Peever soils, and thus, more moisture enters the soil. These soils have a thicker horizon of organic matter accumulation and are calcareous at a depth of more than 10 inches. Aastad and Svea soils are in swales and receive additional moisture through the runoff from adjacent soils. These soils have an even thicker horizon of organic matter accumulation and have carbonates at a greater depth. In low areas where drainage is impeded and the water table is high, the fluctuating water table contributes to the concentration of lime and soluble salts in the upper part of the soil. Soils such as Bearden and Vallers soils formed in these low areas.

Time

The length of time that soil material has been influenced by the other four factors of soil formation is reflected in the kinds of soils that have formed. All soils in Grant County are on relatively young landscapes of the Late Wisconsin glacial period. The youngest soils in the county are those on active flood plains, for example, LaDelle and Playmoor soils.

References

(1) American Association of State Highway [and Transportation] Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 vol., illus.

(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) Flint, Richard Foster. 1955. Pleistocene geology of eastern South Dakota. U.S. Geol. Surv., Prof. Pap. 262, 173 pp., illus.

(4) South Dakota Crop and Livestock Reporting Service. 1924-1975. South Dakota Agricultural Statistics. Annual report.

(5) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplements replacing pp. 173-188 issued May 1962.]

(6) United States Department of Agriculture. 1961. Land capability classification. U.S. Dep. Agric. Handb. 210, 21 pp.

(7) United States Department of Agriculture. 1975. Soil taxonomy: a basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

(8) United States Department of Commerce. 1970. Census of population.

Glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim. An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single mapping unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	More than 9

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to frequent flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Complex, soil. A mapping unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Crop residue management. After harvest, leaving the residue of crops or plants in the field to protect or improve the soil.

Cutbanks cave. Unstable walls of cuts made by earthmoving equipment. The soil sloughs easily.

Deferred grazing. A delay in grazing until range plants have reached a specified stage of growth. Grazing is

deferred in order to increase the vigor of forage and to allow desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

Erosion. The wearing away of the land surface by running water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes a bare surface.

Excess fines. Excess silt and clay. The soil does not provide a source of gravel or sand for construction purposes.

Excess salts. Excess water soluble salts. Excessive salts restrict the growth of most plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake. The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; *November-May*, for example, means that flooding can occur during the period November through May. Water standing for short periods after rainfall or

commonly covering swamps and marshes is not considered flooding.

Foot slope. The inclined surface at the base of a hill.

Frost action. Freezing and thawing of soil moisture. Frost action can damage structures and plant roots.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Horizon, soil. A layer of soil approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon most of which was originally part of a B horizon.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered, but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Large stones. Rock fragments 10 inches (25 centimeters) or more across. Large stones adversely affect the specified use.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. Inadequate strength for supporting loads.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Types are terminal, lateral, medial, and ground.

No-till system. A system of planting crops in which the ground is prepared and the seeds planted in one operation.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by water that originated mainly from the melting of gla-

cial ice. Glacial outwash is commonly in valleys on landforms known as valley trains, outwash terraces, eskers, kame terraces, kames, outwash fans, or deltas.

Outwash plain. A land form of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly. The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are *very slow* (less than 0.06 inch), *slow* (0.06 to 0.20 inch), *moderately slow* (0.2 to 0.6 inch), *moderate* (0.6 to 2.0 inches), *moderately rapid* (2.0 to 6.0 inches), *rapid* (6.0 to 20 inches), and *very rapid* (more than 20 inches).

Piping. Moving water of subsurface tunnels or pipelike cavities in the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Proper grazing use. Grazing range and pasture so that an adequate cover is maintained to protect the soil and so that the quality and quantity of desirable vegetation are maintained or improved.

Range (or rangeland). Land that, for the most part, produces native plants suitable for grazing by livestock; includes land supporting some forest trees.

Range condition. The health or productivity of forage plants on a given range, in terms of the potential productivity under normal climate and the best practical management. Condition classes generally recognized are—*excellent, good, fair,* and *poor*. The classification is based on the percentage of original, or assumed climax vegetation on a site, as compared to what has been observed to grow on it when well managed.

Range site. An area of range where climate, soil, and relief are sufficiently uniform to produce a distinct kind and amount of native vegetation.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Seepage. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake. The slow movement of water into the soil.

Small stones. Rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Small stones adversely affect the specified use.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *very coarse sand* (2.0 millimeters to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt*

(0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil, or partly worked into the soil, to provide protection from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer. Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

TABLES

TABLE 1.--TEMPERATURE AND PRECIPITATION

Month	Temperature[1]						Precipitation[1]				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[2]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	21.5	.9	11.2	48	-28	0	.40	.11	.62	2	6.3
February---	27.8	7.2	17.5	52	-23	0	.61	.18	.95	2	8.9
March------	38.4	18.5	28.3	68	-13	20	.88	.27	1.35	3	7.7
April------	56.6	33.3	45.0	86	14	42	2.40	1.53	3.18	6	2.9
May--------	70.2	45.0	57.6	91	26	251	3.19	1.45	4.61	7	.3
June-------	79.5	55.4	67.4	98	38	522	4.16	2.00	5.91	7	.0
July-------	85.0	60.0	72.5	100	45	698	2.86	1.46	4.00	6	.0
August-----	84.2	58.7	71.4	100	42	663	2.65	1.31	3.74	6	.0
September--	73.8	47.8	60.8	95	29	330	1.65	.61	2.48	4	.0
October----	62.8	37.9	50.4	88	16	137	1.53	.42	2.41	4	.6
November---	42.2	23.0	32.6	71	-4	0	1.00	.27	1.58	2	3.0
December---	28.0	9.5	18.8	53	-23	0	.60	.17	.93	2	6.5
Year-----	55.8	33.1	44.5	102	-28	2,663	21.93	18.15	25.55	51	36.2

[1]Recorded in the period 1951-74 at Milbank, S. Dak.

[2]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Temperature[1]		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 1	May 15	May 24
2 years in 10 later than--	April 26	May 9	May 20
5 years in 10 later than--	April 16	April 29	May 11
First freezing temperature in fall:			
1 year in 10 earlier than--	October 4	September 30	September 15
2 years in 10 earlier than--	October 9	October 5	September 21
5 years in 10 earlier than--	October 21	October 13	October 1

[1]Recorded in the period 1951-74 at Milbank, S. Dak.

TABLE 3.--GROWING SEASON

Probability	Daily minimum temperature during growing season[1]		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	163	146	124
8 years in 10	171	153	130
5 years in 10	187	166	142
2 years in 10	202	180	153
1 year in 10	210	187	159

[1]Recorded in the period 1951-74 at Milbank, S. Dak.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Aa	Aastad-Flom complex	1,930	0.4
AbA	Arvilla sandy loam, 0 to 2 percent slopes	820	0.2
AbB	Arvilla sandy loam, 2 to 6 percent slopes	1,275	0.3
AbC	Arvilla sandy loam, 6 to 9 percent slopes	945	0.2
BaE	Barnes-Buse extremely stony loams, 9 to 40 percent slopes	4,610	1.0
BbB	Barnes-Svea loams, 1 to 6 percent slopes	3,120	0.7
BbC	Barnes-Svea loams, 3 to 9 percent slopes	1,930	0.4
BbD	Barnes-Svea loams, 4 to 15 percent slopes	900	0.2
Bc	Bearden silty clay loam	3,480	0.8
Bd	Brookings silt loam	3,000	0.7
BeF	Buse-Forman loams, 20 to 40 percent slopes	5,630	1.3
BfD	Buse-Forman-Aastad loams, 4 to 15 percent slopes	8,465	1.9
Da	Divide loam	7,075	1.6
Db	Dovray silty clay	6,820	1.6
EaA	Egeland sandy loam, 0 to 2 percent slopes	1,850	0.4
EaB	Egeland sandy loam, 2 to 6 percent slopes	2,905	0.7
Ec	Estelline silty clay loam	1,590	0.4
Fa	Flom clay loam	2,580	0.6
FbA	Fordville loam, 0 to 2 percent slopes	5,170	1.2
FcB	Fordville-Renshaw loams, 2 to 6 percent slopes	1,720	0.4
FdA	Forman-Aastad loams, 0 to 2 percent slopes	7,025	1.6
FdB	Forman-Aastad loams, 1 to 6 percent slopes	43,110	9.8
FdC	Forman-Aastad loams, 3 to 9 percent slopes	14,725	3.4
FdD	Forman-Aastad loams, 4 to 15 percent slopes	12,160	2.8
FeC	Forman-Aastad extremely stony complex, 0 to 9 percent slopes	815	0.2
FgC	Forman-Buse loams, 6 to 9 percent slopes	8,525	1.9
FgE	Forman-Buse loams, 15 to 25 percent slopes	8,930	2.0
FhE	Forman-Buse extremely stony loams, 9 to 40 percent slopes	4,815	1.1
HaD	Hattie clay loam, 9 to 15 percent slopes	4,785	1.1
HaE	Hattie clay loam, 15 to 40 percent slopes	1,670	0.4
HbB	Heimdal-Sisseton loams, 2 to 6 percent slopes	2,680	0.6
HbC	Heimdal-Sisseton loams, 6 to 9 percent slopes	5,935	1.3
HcA	Heimdal-Svea loams, 0 to 2 percent slopes	4,770	1.1
HcB	Heimdal-Svea loams, 2 to 6 percent slopes	14,165	3.3
La	LaDelle silt loam	20,560	4.7
Lb	LaDelle silt loam, channeled	11,760	2.7
Lc	Ludden silty clay	1,905	0.4
MaE	Maddock loamy fine sand, 6 to 25 percent slopes	335	0.1
Mb	Marysland loam	2,710	0.6
Oa	Overly silty clay loam	930	0.2
Pa	Parnell silty clay loam	4,820	1.1
Pb	Parnell silty clay loam, ponded	4,395	1.0
PcA	Peever clay loam, 0 to 2 percent slopes	25,860	5.9
PcB	Peever clay loam, 2 to 6 percent slopes	29,400	6.7
PcC	Peever clay loam, 6 to 9 percent slopes	7,645	1.7
Pd	Peever-Cavour complex	17,200	3.9
Pe	Peever-Tonka complex	1,255	0.3
Pf	Pits, gravel	655	0.1
Ph	Playmoor silty clay loam	4,910	1.1
Po	Poinsett silt loam	1,635	0.4
Ra	Rauville silty clay loam	3,205	0.7
RbA	Renshaw loam, 0 to 2 percent slopes	11,940	2.7
RbB	Renshaw loam, 2 to 6 percent slopes	6,405	1.5
RcD	Renshaw-Sioux complex, 6 to 15 percent slopes	4,170	0.9
RdE	Renshaw-Sioux extremely stony complex, 6 to 40 percent slopes	445	0.1
ReA	Rentill loam, 0 to 2 percent slopes	1,780	0.4
SaE	Sioux-Renshaw complex, 15 to 40 percent slopes	840	0.2
SbE	Sisseton loam, 15 to 40 percent slopes	1,525	0.3
ScD	Sisseton-Heimdal loams, 9 to 15 percent slopes	2,845	0.6
Sd	Svea loam	1,485	0.3
SeA	Swenoda fine sandy loam, 0 to 2 percent slopes	3,985	0.9
Ta	Tonka silt loam	4,690	1.1
Va	Vallers loam	4,435	1.0
Vb	Vallers-Parnell complex	2,280	0.5
Vc	Vallers-Tonka complex	6,255	1.4
VdD	Vienna-Buse complex, 9 to 15 percent slopes	775	0.2
VeA	Vienna-Lismore silt loams, 0 to 2 percent slopes	11,785	2.7
VeB	Vienna-Lismore silt loams, 1 to 6 percent slopes	25,805	5.9
VeC	Vienna-Lismore silt loams, 3 to 9 percent slopes	4,755	1.1
	Water	4,375	1.0
	Total	439,680	100.0

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Corn	Oats	Flax	Spring wheat	Alfalfa hay	Bromegrass-alfalfa
	Bu	Bu	Bu	Bu	Ton	AUM*
Aa: Aastad-Flom	80	82	24	43	3.3	5.3
AbA: Arvilla	30	40	10	20	1.2	2.0
AbB: Arvilla	28	35	8	17	1.0	1.7
AbC: Arvilla	25	25	7	15	.7	1.2
BaE: Barnes-Buse	---	---	---	---	---	---
BbB: Barnes-Svea	68	74	19	35	2.6	4.3
BbC: Barnes-Svea	54	65	14	29	2.4	4.0
BbD: Barnes-Svea	40	53	11	18	2.0	3.3
Bc: Bearden	63	68	18	35	2.8	4.7
Bd: Brookings	70	84	24	40	3.4	5.7
BeF: Buse-Forman	---	---	---	---	---	---
BfD: Buse-Forman-Aastad	52	46	12	20	1.5	2.8
Da: Divide	45	52	13	24	2.4	4.0
Db: Dovray	55	60	15	24	2.8	4.7
EaA: Egeland	47	48	13	22	1.9	3.2
EaB: Egeland	45	45	12	20	1.8	3.0
Ec: Estelline	67	70	18	26	2.7	4.5
Fa: Flom	70	75	22	35	3.5	5.6
FbA: Fordville	51	60	15	25	1.9	3.2
FcB: Fordville-Renshaw	45	43	12	20	1.4	2.3
FdA: Forman-Aastad	72	78	20	37	2.8	4.7
FdB: Forman-Aastad	69	75	19	35	2.7	4.5

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Oats	Flax	Spring wheat	Alfalfa hay	Bromegrass-alfalfa
	Bu	Bu	Bu	Bu	Ton	AUM*
FdC----------------------- Forman-Aastad	54	65	14	27	2.5	4.2
FdD----------------------- Forman-Aastad	40	46	11	20	2.0	3.3
FeC----------------------- Forman-Aastad	---	---	---	---	---	---
FgC----------------------- Forman-Buse	46	48	12	22	2.2	3.7
FgE, FhE------------------ Forman-Buse	---	---	---	---	---	---
HaD----------------------- Hattie	45	45	11	20	2.2	4.0
HaE. Hattie	---	---	---	---	---	---
HbB----------------------- Heimdal-Sisseton	59	60	14	28	2.3	3.8
HbC----------------------- Heimdal-Sisseton	51	50	12	23	2.0	3.3
HcA----------------------- Heimdal-Svea	73	75	22	36	3.0	5.0
HcB----------------------- Heimdal-Svea	70	69	19	34	2.9	4.8
La------------------------ LaDelle	85	83	23	35	3.4	5.7
Lb------------------------ LaDelle	---	---	---	---	3.4	5.7
Lc------------------------ Ludden	---	45	7	14	2.0	3.3
MaE----------------------- Maddock	---	---	---	---	1.5	2.4
Mb------------------------ Marysland	---	---	---	---	---	---
Oa------------------------ Overly	76	81	22	36	3.4	5.7
Pa------------------------ Parnell	---	---	---	---	---	---
Pb------------------------ Parnell	---	---	---	---	---	---
PcA----------------------- Peever	64	71	18	35	2.8	4.7
PcB----------------------- Peever	63	68	17	34	2.7	4.5
PcC----------------------- Peever	54	54	14	29	2.4	3.8
Pd------------------------ Peever-Cavour	55	60	15	28	2.4	3.8
Pe------------------------ Peever-Tonka	59	62	15	25	2.5	4.2

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Oats	Flax	Spring wheat	Alfalfa hay	Bromegrass-alfalfa
	Bu	Bu	Bu	Bu	Ton	AUM*
Ph: Playmoor	---	---	---	---	---	---
Po: Poinsett	70	80	22	33	3.0	5.0
Ra: Rauville	---	---	---	---	---	---
RbA: Renshaw	32	34	10	18	1.1	1.8
RbB: Renshaw	27	32	9	17	1.0	1.7
RcD, RdE: Renshaw-Sioux	---	---	---	---	---	---
ReA: Rentill	50	55	15	25	2.0	3.3
SaE: Sioux-Renshaw	---	---	---	---	---	---
SbE: Sisseton	---	---	---	---	---	---
ScD: Sisseton-Heimdal	31	33	8	15	1.3	2.2
Sd: Svea	75	81	24	36	3.4	5.7
SeA: Swenoda	55	59	16	30	2.3	3.8
Ta**: Tonka	60	52	16	22	3.2	5.3
Va**: Vallers	50	52	13	22	2.6	4.3
Vb: Vallers-Parnell	---	---	---	---	---	---
Vc: Vallers-Tonka	---	---	---	---	---	---
VdD: Vienna-Buse	---	---	---	---	---	---
VeA: Vienna-Lismore	65	70	20	35	2.9	4.8
VeB: Vienna-Lismore	60	68	19	33	2.8	4.7
VeC: Vienna-Lismore	53	65	15	29	2.7	4.5

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

**Predicted yields are for drained areas.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
BaE*:					
Barnes	Silty	Favorable	3,840	Little bluestem	40
		Normal	3,200	Big bluestem	15
		Unfavorable	2,240	Sedge	5
				Needlegrass	25
Buse	Thin Upland	Favorable	3,360	Little bluestem	45
		Normal	2,800	Big bluestem	5
		Unfavorable	1,960	Needlegrass	20
				Sideoats grama	10
				Blue grama	5
				Sedge	5
				Prairie dropseed	5
BeF*:					
Buse	Thin Upland	Favorable	3,360	Little bluestem	45
		Normal	2,800	Sideoats grama	10
		Unfavorable	1,960	Needlegrass	20
				Big bluestem	5
				Blue grama	5
				Prairie dropseed	5
				Sedge	5
Forman	Silty	Favorable	3,840	Big bluestem	15
		Normal	3,200	Little bluestem	35
		Unfavorable	2,240	Needlegrass	30
				Blue grama	5
				Sedge	5
BfD*:					
Buse	Thin Upland	Favorable	3,600	Little bluestem	35
		Normal	3,000	Sideoats grama	10
		Unfavorable	2,100	Needlegrass	20
				Big bluestem	15
				Blue grama	5
				Prairie dropseed	5
				Sedge	5
Forman	Silty	Favorable	4,200	Big bluestem	30
		Normal	3,500	Little bluestem	25
		Unfavorable	2,450	Needlegrass	25
				Blue grama	5
				Sedge	5
Aastad	Overflow	Favorable	6,000	Big bluestem	60
		Normal	5,000	Indiangrass	10
		Unfavorable	3,500	Sedge	10
				Switchgrass	5
FcB*:					
Fordville	Silty	Favorable	4,080	Needlegrass	20
		Normal	3,400	Little bluestem	15
		Unfavorable	2,380	Western wheatgrass	10
				Big bluestem	25
				Sideoats grama	5
				Blue grama	5
				Sedge	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Compo- sition
			Lb/acre		Pct
FcB*:					
Renshaw	Shallow To Gravel	Favorable	3,360	Needleandthread	35
		Normal	2,800	Little bluestem	20
		Unfavorable	1,680	Sideoats grama	15
				Blue grama	5
				Plains muhly	5
FdB*, FdC*, FdD*:					
Forman	Silty	Favorable	4,200	Big bluestem	30
		Normal	3,500	Little bluestem	25
		Unfavorable	2,450	Needlegrass	25
				Blue grama	5
				Sedge	5
Aastad	Overflow	Favorable	6,000	Big bluestem	60
		Normal	5,000	Indiangrass	10
		Unfavorable	3,500	Sedge	10
				Switchgrass	5
FeC*:					
Forman	Silty	Favorable	4,200	Big bluestem	30
		Normal	3,500	Little bluestem	25
		Unfavorable	2,450	Needlegrass	25
				Blue grama	5
				Sedge	5
Aastad	Overflow	Favorable	6,000	Big bluestem	60
		Normal	5,000	Indiangrass	10
		Unfavorable	3,500	Sedge	10
				Switchgrass	5
FgE*:					
Forman	Silty	Favorable	4,200	Big bluestem	30
		Normal	3,500	Little bluestem	25
		Unfavorable	2,450	Needlegrass	25
				Blue grama	5
				Sedge	5
Buse	Thin Upland	Favorable	3,600	Little bluestem	35
		Normal	3,000	Sideoats grama	10
		Unfavorable	2,100	Big bluestem	15
				Blue grama	5
				Prairie dropseed	5
				Sedge	5
FhE*:					
Forman	Silty	Favorable	3,840	Big bluestem	15
		Normal	3,200	Little bluestem	35
		Unfavorable	2,240	Needlegrass	30
				Blue grama	5
				Sedge	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
FhE*:					
Buse	Thin Upland	Favorable	3,360	Little bluestem	45
		Normal	2,800	Sideoats grama	10
		Unfavorable	1,960	Big bluestem	5
				Needlegrass	20
				Prairie dropseed	5
				Blue grama	5
HaE Hattie	Clayey	Favorable	3,720	Little bluestem	35
		Normal	3,100	Big bluestem	20
		Unfavorable	2,170	Porcupinegrass	20
				Kentucky bluegrass	5
				Sedge	5
Lb LaDelle	Overflow	Favorable.	5,520	Big bluestem	60
		Normal	4,600	Needlegrass	15
		Unfavorable	3,220	Indiangrass	5
				Leadplant	5
				Sedge	5
				Switchgrass	5
Lc Ludden	Overflow	Favorable	5,040	Big bluestem	50
		Normal	4,200	Little bluestem	10
		Unfavorabale	2,920	Switchgrass	10
				Indiangrass	5
				Sedge	5
Mb Marysland	Subirrigated	Favorable	5,940	Big bluestem	60
		Normal	5,400	Indiangrass	10
		Unfavorable	4,320	Switchgrass	10
				Sedge	10
				Prairie cordgrass	5
Pa Parnell	Wetland	Favorable	7,150	Prairie cordgrass	65
		Normal	6,500	Sedge	15
		Unfavorable	5,200	Reedgrass	10
				Switchgrass	5
Ra Rauville	Wetland	Favorable	7,200	Prairie cordgrass	85
		Normal	6,600	Sedge	10
		Unfavorable	5,280		
RcD*:					
Renshaw	Shallow To Gravel	Favorable	3,360	Needleandthread	35
		Normal	2,800	Little bluestem	20
		Unfavorable	1,680	Sideoats grama	15
				Blue grama	5
				Plains muhly	5
Sioux	Very Shallow	Favorable	2,400	Blue grama	40
		Normal	2,000	Needleandthread	20
		Unfavorable	1,200	Sideoats grama	15
				Sedge	15
RdE*:					
Renshaw	Shallow To Gravel	Favorable	3,360	Needleandthread	35
		Normal	2,800	Little bluestem	20
		Unfavorable	1,680	Sideoats grama	15
				Blue grama	5
				Plains muhly	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
RdE*:					
Sioux	Very Shallow	Favorable	2,400	Blue grama	40
		Normal	2,000	Needleandthread	20
		Unfavorable	1,200	Sideoats grama	15
				Sedge	15
SaE*:					
Sioux	Very Shallow	Favorable	2,400	Blue grama	40
		Normal	2,000	Needleandthread	20
		Unfavorable	1,200	Sideoats grama	15
				Sedge	15
Renshaw	Shallow To Gravel	Favorable	3,360	Needleandthread	35
		Normal	2,800	Little bluestem	20
		Unfavorable	1,680	Sideoats grama	15
				Blue grama	5
				Plains muhly	5
SbE: Sisseton	Thin Upland	Favorable	3,600	Little bluestem	40
		Normal	3,000	Needlegrass	20
		Unfavorable	2,100	Prairie dropseed	10
				Big bluestem	5
				Sideoats grama	5
				Blue grama	5
				Sedge	5
ScD*:					
Sisseton	Thin Upland	Favorable	3,840	Little bluestem	35
		Normal	3,200	Needlegrass	20
		Unfavorable	2,240	Prairie dropseed	10
				Big bluestem	10
				Sideoats grama	5
				Blue grama	5
				Sedge	5
Heimdal	Silty	Favorable	4,080	Little bluestem	30
		Normal	3,400	Needlegrass	25
		Unfavorable	2,380	Blue grama	5
				Sedge	5
				Big bluestem	25
Ta: Tonka	Wetland	Favorable	6,600	Prairie cordgrass	65
		Normal	6,000	Reedgrass	10
		Unfavorable	4,800	Switchgrass	5
				Sedge	15
Vb*:					
Vallers	Subirrigated	Favorable	6,380	Big bluestem	60
		Normal	5,800	Switchgrass	10
		Unfavorable	4,640	Indiangrass	10
				Sedge	10
				Kentucky bluegrass	5
Parnell	Wetland	Favorable	7,150	Prairie cordgrass	65
		Normal	6,500	Sedge	15
		Unfavorable	5,200	Reedgrass	10
				Switchgrass	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
VdD*:					
Vienna	Silty	Favorable	4,200	Little bluestem	30
		Normal	3,500	Needlegrass	25
		Unfavorable	2,450	Big bluestem	20
				Kentucky bluegrass	5
				Sideoats grama	5
				Blue grama	5
				Sedge	5
Buse	Thin Upland	Favorable	3,800	Little bluestem	35
		Normal	3,200	Sideoats grama	10
		Unfavorable	2,800	Needlegrass	20
				Big bluestem	15
				Blue grama	5
				Prairie dropseed	5
				Sedge	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Aa*:					
Aastad	---	Siberian peashrub, American plum, lilac, Tatarian honeysuckle.	Ponderosa pine, blue spruce, Siberian crabapple, eastern redcedar.	Golden willow, common hackberry, green ash, honeylocust.	Eastern cottonwood, Siberian elm.
Flom	Lilac, silver buffaloberry.	Siberian peashrub, Tatarian honeysuckle, redosier dogwood.	Eastern redcedar, Siberian crab-apple, ponderosa pine, blue spruce, common hackberry, Russian-olive.	Golden willow, green ash, honeylocust.	Eastern cottonwood.
AbA, AbB, AbC Arvilla	Tatarian honey-suckle, lilac, Peking coton-easter.	Siberian crab-apple, eastern redcedar, Rocky Mt. juniper, Siberian peashrub.	Honeylocust, green ash, Russian-olive, ponderosa pine.	Siberian elm	---
BaE*:					
Barnes.					
Buse.					
BbB*, BbC*, BbD*:					
Barnes	Lilac	Eastern redcedar, common chokecherry, Siberian peashrub, American plum, silver buffaloberry.	Ponderosa pine, common hackberry, Russian-olive, Siberian crabapple, blue spruce.	Honeylocust, green ash.	Siberian elm.
Svea	---	Siberian peashrub, Tatarian honeysuckle, American plum, lilac.	Siberian crab-apple, blue spruce, ponderosa pine, eastern redcedar.	Golden willow, common hackberry, green ash, honeylocust.	Eastern cottonwood, Siberian elm.
Bc Bearden	---	Tatarian honey-suckle, Siberian peashrub, American plum, lilac.	Blue spruce, Siberian crabapple, eastern redcedar, ponderosa pine.	Golden willow, common hackberry, green ash, honeylocust.	Eastern cottonwood, Siberian elm.
Bd Brookings	---	Siberian peashrub, American plum, lilac, Tatarian honeysuckle.	Ponderosa pine, blue spruce, Siberian crabapple, eastern redcedar.	Golden willow, green ash, common hackberry, honeylocust.	Eastern cottonwood, Siberian elm.
BeF*:					
Buse.					
Forman.					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
BfD*: Buse.					
Forman	Lilac	Eastern redcedar, common chokecherry, Siberian peashrub, American plum, silver buffaloberry.	Ponderosa pine, common hackberry, Russian-olive, Siberian crabapple, blue spruce.	Honeylocust, green ash.	Siberian elm.
Aastad	---	Siberian peashrub, American plum, lilac, Tatarian honeysuckle.	Ponderosa pine, blue spruce, Siberian crabapple, eastern redcedar.	Golden willow, common hackberry, green ash, honeylocust.	Eastern cottonwood, Siberian elm.
Da: Divide	---	Tatarian honeysuckle, Siberian peashrub, American plum, lilac.	Ponderosa pine, Siberian crabapple, eastern redcedar, blue spruce.	Golden willow, green ash, common hackberry, honeylocust.	Eastern cottonwood, Siberian elm.
Db: Dovray	Lilac, silver buffaloberry.	Siberian peashrub, Tatarian honeysuckle, redosier dogwood.	Eastern redcedar, blue spruce, ponderosa pine, common hackberry, Russian-olive, Siberian crabapple.	Golden willow, green ash.	Eastern cottonwood.
EaA, EaB: Egeland	---	Eastern redcedar, Tatarian honeysuckle, Siberian peashrub, lilac, American plum.	Green ash, common hackberry, ponderosa pine, Russian-olive, Siberian crabapple.	Siberian elm, honeylocust.	---
Ec: Estelline	Tatarian honeysuckle, Peking cotoneaster, lilac.	Siberian crabapple, eastern redcedar, Rocky Mt. juniper, Siberian peashrub.	Honeylocust, green ash, Russian-olive, ponderosa pine.	Siberian elm	---
Fa: Flom	Lilac, silver buffaloberry.	Siberian peashrub, Tatarian honeysuckle.	Eastern redcedar, Siberian crabapple, ponderosa pine, blue spruce, common hackberry, Russian-olive.	Golden willow, green ash, honeylocust.	Eastern cottonwood.
FbA: Fordville	Tatarian honeysuckle, Peking cotoneaster, lilac.	Siberian crabapple, eastern redcedar, Rocky Mt. juniper, Siberian peashrub.	Honeylocust, green ash, Russian-olive, ponderosa pine.	Siberian elm	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
FcB*:					
Fordville	Tatarian honeysuckle, Peking cotoneaster, lilac.	Siberian crabapple, eastern redcedar, Rocky Mt. juniper, Siberian peashrub.	Honeylocust, green ash, Russian-olive, ponderosa pine.	Siberian elm	---
Renshaw.					
FdA*, FdB*, FdC* FdD*:					
Forman	Lilac	Eastern redcedar, common chokecherry, Siberian peashrub, American plum, silver buffaloberry.	Ponderosa pine, common hackberry, Russian-olive, Siberian crabapple, blue spruce.	Honeylocust, green ash.	Siberian elm.
Aastad	---	Siberian peashrub, American plum, lilac, Tatarian honeysuckle.	Ponderosa pine, blue spruce, Siberian crabapple, eastern redcedar.	Golden willow, common hackberry, green ash, honeylocust.	Eastern cottonwood, Siberian elm.
FeC*:					
Forman.					
Aastad	---	Siberian peashrub, American plum, lilac, Tatarian honeysuckle.	Ponderosa pine, blue spruce, Siberian crabapple, eastern redcedar.	Golden willow, common hackberry, green ash, honeylocust.	Eastern cottonwood, Siberian elm.
FgC*:					
Forman	Lilac	Eastern redcedar, common chokecherry, Siberian peashrub, American plum, silver buffaloberry.	Ponderosa pine, green ash, common hackberry, Russian-olive, Siberian crabapple, blue spruce.	Honeylocust, green ash.	Siberian elm.
Buse	American plum, silver buffaloberry.	Eastern redcedar, common hackberry, Russian-olive, Siberian peashrub, Tatarian honeysuckle, Rocky Mt. juniper.	Honeylocust, ponderosa pine, Siberian elm, green ash.	---	---
FgE*:					
Forman.					
Buse.					
FhE*:					
Forman.					
Buse.					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
HaD, HaE. Hattie					
HbB*, HbC*: Heimdal	Lilac	Eastern redcedar, common chokecherry, Siberian peashrub, American plum, silver buffaloberry.	Ponderosa pine, common hackberry, Russian-olive, Siberian crab-apple, blue spruce.	Honeylocust, green ash.	Siberian elm.
Sisseton	American plum, silver buffaloberry.	Russian-olive, common hackberry, Rocky Mt. juniper, eastern redcedar, Siberian peashrub, Tatarian honeysuckle.	Siberian elm, ponderosa pine, green ash, honeylocust.	---	---
HcA*, HcB*: Heimdal	Lilac	Eastern redcedar, common chokecherry, Siberian peashrub, American plum, silver buffaloberry.	Ponderosa pine, common hackberry, Russian-olive, Siberian crab-apple, blue spruce.	Honeylocust, green ash.	Siberian elm.
Svea	---	Siberian peashrub, Tatarian honeysuckle, lilac, American plum.	Siberian crab-apple, blue spruce, ponderosa pine, eastern redcedar.	Golden willow, common hackberry, green ash, honeylocust.	Eastern cottonwood, Siberian elm.
La, Lb LaDelle	---	Siberian peashrub, American plum, lilac, Tatarian honeysuckle.	Ponderosa pine, blue spruce, Siberian crabapple, eastern redcedar.	Golden willow, green ash, common hackberry, honeylocust.	Eastern cottonwood, Siberian elm.
Lc Ludden	Lilac, silver buffaloberry.	Tatarian honey-suckle, Siberian peashrub, redosier dogwood.	Common hackberry, blue spruce, Russian-olive, ponderosa pine, Siberian crabapple, eastern redcedar.	Honeylocust, golden willow, green ash.	Eastern cottonwood.
MaE Maddock	---	Ponderosa pine, eastern redcedar, Rocky Mt. juniper.	---	---	---
Mb Marysland	Lilac, silver buffaloberry.	Tatarian honeysuckle, Siberian peashrub, redosier dogwood.	Russian-olive, Siberian crab-apple, eastern redcedar, common hackberry, blue spruce, ponderosa pine.	Golden willow, green ash, honeylocust.	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
Oa Overly	---	Tatarian honeysuckle, Siberian peashrub, American plum, lilac.	Ponderosa pine, blue spruce, Siberian crabapple, eastern redcedar.	Golden willow, honeylocust, green ash, common hackberry.	Eastern cottonwood, Siberian elm.
Pa. Parnell					
Pb. Parnell					
PcA, PcB, PcC Peever	Lilac	Siberian crabapple, Tatarian honeysuckle, American plum, Siberian peashrub.	Honeylocust, ponderosa pine, common hackberry, Russian-olive, eastern redcedar.	Siberian elm, green ash.	---
Pd*:					
Peever	Lilac	Siberian crabapple, Tatarian honeysuckle, American plum, Siberian peashrub.	Honeylocust, ponderosa pine, common hackberry, Russian-olive, eastern redcedar.	Siberian elm, green ash.	---
Cavour	Siberian peashrub, silver buffaloberry, lilac.	Siberian elm, green ash, ponderosa pine, Russian-olive, eastern redcedar, Rocky Mt. juniper.	---	---	---
Pe*:					
Peever	Lilac	Siberian crabapple, Tatarian honeysuckle, American plum, Siberian peashrub.	Honeylocust, ponderosa pine, common hackberry, Russian-olive, eastern redcedar.	Siberian elm, green ash.	---
Tonka.					
Ph. Playmoor					
Po Poinsett	---	Eastern redcedar, Siberian peashrub, American plum, lilac.	Common hackberry, blue spruce, ponderosa pine, Russian-olive, Siberian crabapple.	Honeylocust, green ash.	Siberian elm.
Ra. Rauville					
RbA, RbB. Renshaw					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
RcD*, RdE*: Renshaw.					
Sioux.					
ReA: Rentill	Lilac	Eastern redcedar, common chokecherry, Siberian peashrub, American plum, silver buffaloberry.	Ponderosa pine, common hackberry, Russian-olive, blue spruce, Siberian crabapple.	Honeylocust, green ash.	Siberian elm.
SaE*: Sioux.					
Renshaw.					
SbE. Sisseton					
ScD*: Sisseton.					
Heimdal	Lilac	Eastern redcedar, common chokecherry, Siberian peashrub, American plum, silver buffaloberry.	Ponderosa pine, common hackberry, Russian-olive, Siberian crabapple, blue spruce.	Honeylocust, green ash.	Siberian elm.
Sd: Svea	---	Siberian peashrub, Tatarian honeysuckle, American plum, lilac.	Siberian crab-apple, blue spruce, ponderosa pine, eastern redcedar.	Golden willow, common hackberry, green ash, honeylocust.	Eastern cottonwood, Siberian elm.
SeA: Swenoda	---	Eastern redcedar, Tatarian honeysuckle, Siberian peashrub, lilac, American plum.	Green ash, common hackberry, ponderosa pine, Russian-olive, Siberian crabapple.	Siberian elm, honeylocust.	---
Ta. Tonka					
Va: Vallers	Lilac, silver buffaloberry.	Redosier dogwood, Tatarian honey-suckle, Siberian peashrub.	Russian-olive, blue spruce, ponderosa pine, eastern redcedar, common hackberry, Siberian crab-apple.	Golden willow, green ash, honeylocust.	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Vb*:					
Vallers	Lilac, silver buffaloberry.	Redosier dogwood, Tatarian honeysuckle, Siberian peashrub.	Russian-olive, blue spruce, ponderosa pine, eastern redcedar, common hackberry, Siberian crabapple.	Golden willow, green ash, honeylocust.	Eastern cottonwood.
Parnell.					
Vc*:					
Vallers	Lilac, silver buffaloberry.	Redosier dogwood, Tatarian honeysuckle, Siberian peashrub.	Russian-olive, blue spruce, ponderosa pine, eastern redcedar, common hackberry, Siberian crabapple.	Golden willow, green ash, honeylocust.	Eastern cottonwood.
Tonka.					
VdD*:					
Vienna	Lilac	Russian-olive, common chokecherry, Siberian peashrub, American plum, silver buffaloberry.	Ponderosa pine, common hackberry, Russian-olive, Siberian crabapple, blue spruce.	Honeylocust, green ash.	Siberian elm.
Buse.					
VeA*, VeB*, VeC*:					
Vienna	Lilac	Russian-olive, common chokecherry, Siberian peashrub, American plum, silver buffaloberry.	Ponderosa pine, common hackberry, Russian-olive, Siberian crabapple, blue spruce.	Honeylocust, green ash.	Siberian elm.
Lismore	---	Siberian peashrub, American plum, lilac, Tatarian honeysuckle.	Ponderosa pine, blue spruce, Siberian crabapple, eastern redcedar.	Golden willow, green ash, common hackberry, honeylocust.	Eastern cottonwood, Siberian elm.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
Aa*:									
Aastad	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
Flom	Good	Good	Fair	Good	Fair	Fair	Good	Fair	Fair.
AbA Arvilla	Fair	Fair	Poor	Poor	Very poor	Very poor	Fair	Very poor	Poor.
AbB, AbC Arvilla	Poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
BaE*:									
Barnes	Very poor	Poor	Good	Poor	Very poor	Very poor	Very poor	Very poor	Good.
Buse	Very poor	Very poor	Fair	Poor	Very poor	Very poor	Very poor	Very poor	Fair.
BbB*:									
Barnes	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
Svea	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Fair.
BbC*:									
Barnes	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Svea	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
BbD*:									
Barnes	Poor	Good	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
Svea	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Bc Bearden	Good	Good	Good	Good	Poor	Poor	Good	Poor	Good.
Bd Brookings	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
BeF*:									
Buse	Very poor	Very poor	Fair	Poor	Very poor	Very poor	Very poor	Very poor	Fair.
Forman	Very poor	Very poor	Good	Poor	Very poor	Very poor	Very poor	Very poor	Good.
BfD*:									
Buse	Very poor	Fair	Fair	Poor	Very poor	Very poor	Very poor	Very poor	Fair.
Forman	Poor	Good	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
Aastad	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
Da Divide	Fair	Fair	Good	Good	Poor	Poor	Poor	Poor	Good.
Db Dovray	Good	Good	Good	Good	Fair	Fair	Good	Fair	Good.
EaA, EaB Egeland	Fair	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Good.
Ec Estelline	Good	Fair	Good	Poor	Very poor	Very poor	Fair	Very poor	Good.
Fa Flom	Good	Good	Fair	Good	Fair	Fair	Good	Fair	Fair.
FbA Fordville	Good	Fair	Good	Poor	Very poor	Very poor	Fair	Very poor	Good.

See footnote at end of table.

TABLE 8.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
FcB*:									
Fordville	Fair	Fair	Good	Poor	Very poor	Very poor	Fair	Very poor	Good.
Renshaw	Fair	Fair	Poor	Poor	Very poor	Very poor	Fair	Very poor	Poor.
FdA*, FdB*:									
Forman	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Aastad	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
FdC*:									
Forman	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Aastad	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
FdD*:									
Forman	Poor	Good	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
Aastad	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
FeC*:									
Forman	Very poor	Very poor	Good	Poor	Very poor	Very poor	Very poor	Very poor	Good.
Aastad	Very poor	Good	Fair	Good	Very poor	Very poor	Poor	Very poor	Fair.
FgC*:									
Forman	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Buse	Poor	Fair	Fair	Poor	Very poor	Very poor	Poor	Very poor	Fair.
FgE*:									
Forman	Very poor	Poor	Good	Poor	Very poor	Very poor	Very poor	Very poor	Good.
Buse	Very poor	Poor	Fair	Poor	Very poor	Very poor	Very poor	Very poor	Fair.
FhE*:									
Forman	Very poor	Very poor	Good	Poor	Very poor	Very poor	Very poor	Very poor	Good.
Buse	Very poor	Very poor	Fair	Poor	Very poor	Very poor	Very poor	Very poor	Fair.
HaD Hattie	Poor	Fair	Good	Fair	Very poor	Very poor	Poor	Very poor	Good.
HaE Hattie	Very poor	Poor	Good	Poor	Very poor	Very poor	Very poor	Very poor	Good.
HbB*:									
Heimdal	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Sisseton	Good	Fair	Fair	Poor	Very poor	Very poor	Fair	Very poor	Fair.
HbC*:									
Heimdal	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Sisseton	Fair	Fair	Fair	Poor	Very poor	Very poor	Fair	Very poor	Fair.
HcA*, HcB*:									
Heimdal	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Svea	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
La LaDelle	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
Lb LaDelle	Very poor	Poor	Poor	Poor	Poor	Poor	Very poor	Poor	Poor.
Lc Ludden	Good	Poor	Fair	Poor	Fair	Good	Fair	Good	Fair.

See footnote at end of table.

TABLE 8.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Wetland wildlife	Rangeland wildlife
MaE: Maddock	Very poor	Poor	Fair	Poor	Very poor	Very poor	Very poor	Very poor	Fair.
Mb: Marysland	Poor	Poor	Fair	Good	Fair	Fair	Poor	Fair	Fair.
Oa: Overly	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Pa: Parnell	Very poor	Poor	Fair	Poor	Good	Good	Very poor	Good	Fair.
Pb: Parnell	Very poor	Very poor	Very poor	Very poor	Good	Good	Very poor	Good	Very poor.
PcA: Peever	Good	Fair	Good	Fair	Very poor	Very poor	Good	Very poor	Good.
PcB: Peever	Fair	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Good.
PcC: Peever	Fair	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Good.
Pd*:									
Peever	Good	Fair	Good	Fair	Very poor	Very poor	Good	Very poor	Good.
Cavour	Poor	Poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Pe*:									
Peever	Good	Fair	Good	Fair	Very poor	Very poor	Good	Very poor	Good.
Toñka	Poor	Poor	Fair	Poor	Good	Good	Poor	Good	Fair.
Ph: Playmoor	Poor	Poor	Fair	Poor	Fair	Fair	Poor	Fair	Fair.
Po: Poinsett	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Ra: Rauville	Very poor	Poor	Fair	Poor	Fair	Fair	Very poor	Fair	Fair.
RbA: Renshaw	Fair	Fair	Poor	Poor	Very poor	Very poor	Fair	Very poor	Poor.
RbB: Renshaw	Poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
RcD*, RdE*:									
Renshaw	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
Sioux	Very poor	Very poor	Very poor	Poor	Very poor	Very poor	Very poor	Very poor	Very poor.
ReA: Rentill	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
SaE*:									
Sioux	Very poor	Very poor	Very poor	Poor	Very poor	Very poor	Very poor	Very poor	Very poor.
Renshaw	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.

See footnote at end of table.

TABLE 8.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hardwood trees	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
SbE----------------- Sisseton	Very poor	Very poor	Fair	Poor	Very poor	Very poor	Very poor	Very poor	Fair.
ScD*:									
Sisseton-----------	Very poor	Poor	Fair	Poor	Very poor	Very poor	Very poor	Very poor	Fair.
Heimdal------------	Poor	Good	Good	Good	Very poor	Very poor	Fai	Very poor	Good.
Sd----------------- Svea	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Good.
SeA---------------- Swenoda	Fair	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Good.
Ta----------------- Tonka	Poor	Poor	Fair	Poor	Good	Good	Poor	Good	Fair.
Va----------------- Vallers	Poor	Poor	Fair	Good	Fair	Fair	Poor	Fair	Fair.
Vb*:									
Vallers------------	Poor	Poor	Fair	Good	Fair	Fair	Poor	Fair	Fair.
Parnell------------	Very poor	Poor	Fair	Poor	Good	Good	Very poor	Good	Fair.
Vc*:									
Vallers------------	Poor	Poor	Fair	Good	Fair	Fair	Poor	Fair	Fair.
Tonka--------------	Poor	Poor	Fair	Poor	Good	Good	Poor	Good	Fair.
VdD*:									
Vienna-------------	Poor	Good	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
Buse---------------	Very poor	Poor	Fair	Poor	Very poor	Very poor	Very poor	Very poor	Fair.
VeA*, VeB*									
Vienna-------------	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Lismore------------	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
VeC*:									
Vienna-------------	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Lismore------------	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Aa*:				
Aastad	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
Flom	Severe: floods, wetness.	Moderate: wetness, too clayey.	Severe: wetness.	Moderate: too clayey, wetness.
AbA Arvilla	Slight	Slight	Slight	Slight.
AbB Arvilla	Slight	Slight	Moderate: slope.	Slight.
AbC Arvilla	Slight	Slight	Severe: slope.	Slight.
BaE*:				
Barnes	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Buse	Severe: slope, large stones.	Severe: slope, large stones.	Severe: large stones, slope.	Severe: large stones.
BbB*:				
Barnes	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.
Svea	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
BbC*:				
Barnes	Moderate: percs slowly.	Slight	Severe: slope.	Slight.
Svea	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
BbD*:				
Barnes	Moderate: slope, percs slowly.	Moderate: slope.	Severe: slope.	Slight.
Svea	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
Bc Bearden	Moderate: wetness, percs slowly, too clayey.	Moderate: wetness, too clayey.	Moderate: too clayey, wetness, percs slowly.	Moderate: too clayey.
Bd Brookings	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
BeF*:				
Buse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Forman	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
BfD*:				
Buse	Moderate: slope, percs slowly.	Moderate: slope.	Severe: slope.	Slight.
Forman	Moderate: slope, percs slowly.	Moderate: slope.	Severe: slope.	Slight.
Aastad	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
Da Divide	Slight	Slight	Slight	Slight.
Db Dovray	Severe: wetness, too clayey, floods.	Severe: wetness, too clayey.	Severe: wetness, too clayey, floods.	Severe: wetness, too clayey.
EaA Egeland	Slight	Slight	Slight	Slight.
EaB Egeland	Slight	Slight	Moderate: slope.	Slight.
Ec Estelline	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
Fa Flom	Severe: floods, wetness.	Moderate: wetness, too clayey.	Severe: wetness.	Moderate: too clayey, wetness.
FbA Fordville	Slight	Slight	Slight	Slight.
FcB*:				
Fordville	Slight	Slight	Moderate: slope.	Slight.
Renshaw	Slight	Slight	Moderate: slope.	Slight.
FdA*:				
Forman	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight.
Aastad	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
FdB*:				
Forman	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.
Aastad	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
FdC*:				
Forman	Moderate: percs slowly.	Slight	Severe: slope.	Slight.
Aastad	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
FdD*:				
Forman	Moderate: slope, percs slowly.	Moderate: slope.	Severe: slope.	Slight.
Aastad	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
FeC*:				
Forman	Severe: large stones.	Severe: large stones.	Severe: large stones.	Severe: large stones.
Aastad	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
FgC*:				
Forman	Moderate: percs slowly.	Slight	Severe: slope.	Slight.
Buse	Moderate: percs slowly.	Slight	Severe: slope.	Slight.
FgE*:				
Forman	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Buse	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
FhE*:				
Forman	Severe: large stones, slope.	Severe: large stones, slope.	Severe: large stones, slope.	Severe: large stones.
Buse	Severe: slope, large stones.	Severe: slope, large stones.	Severe: large stones, slope.	Severe: large stones.
HaD Hattie	Moderate: slope, percs slowly.	Moderate: too clayey, slope.	Severe: slope.	Moderate: too clayey.
HaE Hattie	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
HbB*:				
Heimdal	Slight	Slight	Moderate: slope.	Slight.
Sisseton	Slight	Slight	Moderate: slope.	Slight.
HbC*:				
Heimdal	Slight	Slight	Severe: slope.	Slight.
Sisseton	Slight	Slight	Severe: slope.	Slight.
HcA*:				
Heimdal	Slight	Slight	Slight	Slight.
Svea	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
HcB*:				
Heimdal	Slight	Slight	Moderate: slope.	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
HcB*:				
Svea	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
La, Lb LaDelle	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
Lc Ludden	Severe: too clayey, floods, wetness.	Severe: too clayey, wetness.	Severe: too clayey, floods, wetness.	Severe: too clayey, wetness.
MaE Maddock	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too sandy, slope.
Mb Marysland	Severe: wetness, floods.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Oa Overly	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
Pa Parnell	Severe: floods, wetness, too clayey.	Severe: too clayey, wetness.	Severe: too clayey, floods, wetness.	Severe: too clayey, wetness.
Pb Parnell	Severe: floods, wetness.	Severe: wetness.	Severe: floods, wetness.	Severe: wetness.
PcA Peever	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey.
PcB Peever	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Moderate: slope, too clayey, percs slowly.	Moderate: too clayey.
PcC Peever	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Severe: slope.	Moderate: too clayey.
Pd*:				
Peever	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey.
Cavour	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight.
Pe*:				
Peever	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey.
Tonka	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Ph: Playmoor	Severe: floods, wetness.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.
Po: Poinsett	Slight	Slight	Slight	Slight.
Ra: Rauville	Severe: floods, wetness.	Severe: wetness.	Severe: floods, wetness.	Severe: wetness.
RbA: Renshaw	Slight	Slight	Slight	Slight.
RbB: Renshaw	Slight	Slight	Moderate: slope.	Slight.
RcD*:				
Renshaw	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Sioux	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
RdE*:				
Renshaw	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Sioux	Severe: slope.	Severe: slope.	Severe: large stones, slope, small stones.	Moderate: large stones, slope, small stones.
ReA: Rentill	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight.
SaE*:				
Sioux	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Renshaw	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
SbE: Sisseton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
ScD*:				
Sisseton	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Heimdal	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Sd: Svea	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
SeA: Swenoda	Slight	Slight	Slight	Slight.
Ta: Tonka	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Va: Vallers	Severe: wetness floods.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
Vb*:				
Vallers	Severe: wetness, floods.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
Parnell	Severe: floods, wetness, too clayey.	Severe: too clayey, wetness.	Severe: too clayey, floods, wetness.	Severe: too clayey, wetness.
Vc*:				
Vallers	Severe: wetness, floods.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
Tonka	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.
VdD*:				
Vienna	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Buse	Moderate: slope, percs slowly.	Moderate: slope.	Severe: slope.	Slight.
VeA*:				
Vienna	Slight	Slight	Slight	Slight.
Lismore	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
VeB*:				
Vienna	Slight	Slight	Moderate: slope.	Slight.
Lismore	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
VeC*:				
Vienna	Slight	Slight	Severe: slope.	Slight.
Lismore	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Aa*:					
Aastad	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, low strength.
Flom	Severe: wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, low strength, frost action.
AbA Arvilla	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
AbB, AbC Arvilla	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
BaE*:					
Barnes	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Buse	Severe: large stones, slope.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.
BbB*, BbC*:					
Barnes	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Moderate: frost action, low strength, shrink-swell.
Svea	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, low strength.
BbD*:					
Barnes	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: frost action, slope, low strength.
Svea	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, low strength.
Bc Bearden	Severe: wetness.	Moderate: wetness, shrink-swell, low strength.	Severe: wetness.	Moderate: wetness, shrink-swell, low strength.	Severe: frost action, low strength.
Bd Brookings	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, low strength, frost action.
BeF*:					
Buse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
Forman	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: frost action, shrink-swell, low strength.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
BfD*:					
Buse	Moderate: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: shrink-swell, slope, low strength.	Severe: slope.	Severe: low strength.
Forman	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, slope.	Severe: slope.	Moderate: frost action, shrink-swell, low strength.
Aastad	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, low strength.
Da Divide	Severe: cutbanks cave.	Moderate: low strength.	Moderate: wetness.	Moderate: low strength.	Severe: low strength.
Db Dovray	Severe: wetness, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, floods, low strength.
EaA Egeland	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
EaB Egeland	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
Ec Estelline	Severe: cutbanks cave.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell.	Moderate: shrink-swell, low strength.	Severe: low strength.
Fa Flom	Severe: wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, low strength, frost action.
FbA Fordville	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: low strength.
FcB*:					
Fordville	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: low strength.
Renshaw	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
FdA*:					
Forman	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: frost action, shrink-swell, low strength.
Aastad	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, low strength.
FdB*, FdC*:					
Forman	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: frost action, shrink-swell, low strength.
Aastad	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, low strength.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
FdD*:					
Forman	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, slope.	Severe: slope.	Moderate: frost action, shrink-swell, low strength.
Aastad	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, low strength.
FeC*:					
Forman	Severe: large stones.	Severe: large stones.	Severe: large stones.	Severe: large stones.	Severe: large stones.
Aastad	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, low strength.
FgC*:					
Forman	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, slope, low strength.	Moderate: frost action, shrink-swell, low strength.
Buse	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
FgE*:					
Forman	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: frost action, shrink-swell, low strength.
Buse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
FhE*:					
Forman	Severe: large stones, slope.	Severe: large stones, slope.	Severe: large stones, slope.	Severe: slope, large stones.	Severe: large stones.
Buse	Severe: large stones, slope.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.
HaD Hattie	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, slope, low strength.	Severe: low strength, shrink-swell.
HaE Hattie	Severe: too clayey, slope.	Severe: shrink-swell, slope, low strength.	Severe: shrink-swell, slope, low strength.	Severe: shrink-swell, slope, low strength.	Severe: slope, shrink-swell, low strength.
HbB*, HbC*:					
Heimdal	Slight	Moderate: low strength.	Moderate: low strength.	Moderate: slope, low strength.	Moderate: frost action, low strength.
Sisseton	Slight	Moderate: low strength.	Moderate: low strength.	Moderate: slope, low strength.	Moderate: frost action, low strength.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
HcA*:					
Heimdal	Slight	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Moderate: frost action, low strength.
Svea	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, low strength.
HcB*:					
Heimdal	Slight	Moderate: low strength.	Moderate: low strength.	Moderate: slope, low strength.	Moderate: frost action, low strength.
Svea	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, low strength.
La, Lb LaDelle	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, frost action, low strength.
Lc Ludden	Severe: floods, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: low strength, wetness, floods.
MaE Maddock	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Mb Marysland	Severe: wetness, cutbanks cave.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, low strength.
Oa Overly	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: frost action, low strength.
Pa Parnell	Severe: floods, wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, low strength.
Pb Parnell	Severe: floods, wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: low strength, wetness, floods.
PcA, PcB, PcC Peever	Moderate: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
Pd*:					
Peever	Moderate: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, llow strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
Cavour	Moderate: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Pe*:					
Peever	Moderate: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
Tonka	Severe: wetness, floods.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, low strength.
Ph: Playmoor	Severe: floods, wetness.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.
Po: Poinsett	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: frost action, low strength.
Ra: Rauville	Severe: floods, wetness.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.	Severe: low strength, wetness, floods.
RbA: Renshaw	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
RbB: Renshaw	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
RcD*:					
Renshaw	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Sioux	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
RdE*:					
Renshaw	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Sioux	Severe: slope, cutbanks cave.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
ReA: Rentill	Moderate: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
SaE*:					
Sioux	Severe: slope, cutbanks cave.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Renshaw	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
SbE: Sisseton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
ScD*:					
Sisseton	Moderate: slope.	Moderate: slope, low strength.	Moderate: slope, low strength.	Severe: slope.	Moderate: slope, frost action, low strength.
Heimdal	Moderate: slope.	Moderate: slope, low strength.	Moderate: slope.	Severe: slope.	Moderate: frost action, low strength, slope.
Sd: Svea	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, low strength.
SeA: Swenoda	Moderate: wetness.	Moderate: shrink-swell, low strength.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, low strength.	Moderate: low strength, wetness, shrink-swell.
Ta: Tonka	Severe: wetness, floods.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, low strength.
Va: Vallers	Severe: wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, frost action, low strength.
Vb*:					
Vallers	Severe: wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, frost action, low strength.
Parnell	Severe: floods, wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, low strength.
Vc*:					
Vallers	Severe: wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, frost action, low strength.
Tonka	Severe: wetness, floods.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, low strength.
VdD*:					
Vienna	Moderate: slope.	Moderate: slope, shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: slope.	Severe: low strength, frost action.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
VdD*:					
Buse	Moderate: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: shrink-swell, slope, low strength.	Severe: slope.	Severe: low strength.
VeA*:					
Vienna	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength, frost action.
Lismore	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods, frost action.
VeB*, VeC*:					
Vienna	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: low strength, frost action.
Lismore	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods, frost action.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Aa*:					
Aastad	Severe: floods, wetness, percs slowly.	Slight	Severe: floods, wetness.	Severe: floods.	Fair: too clayey.
Flom	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
AbA, AbB Arvilla	Slight	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage, small stones.
AbC Arvilla	Slight	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage, small stones.
BaE*:					
Barnes	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Buse	Severe: percs slowly, slope, large stones.	Severe: slope, large stones.	Severe: large stones.	Severe: slope.	Poor: slope, large stones.
BbB*:					
Barnes	Severe: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
Svea	Severe: percs slowly, floods.	Slight	Severe: wetness, floods.	Severe: floods.	Fair: too clayey.
BbC*:					
Barnes	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Svea	Severe: percs slowly, floods.	Slight	Severe: wetness, floods.	Severe: floods.	Fair: too clayey.
BbD*:					
Barnes	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: slope, too clayey.
Svea	Severe: percs slowly, floods.	Slight	Severe: wetness, floods.	Severe: floods.	Fair: too clayey.
Bc Bearden	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
Bd Brookings	Severe: floods, percs slowly.	Slight	Severe: floods.	Severe: floods.	Fair: too clayey.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
BeF*:					
Buse	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Forman	Severe: percs slowly, slope.	Severe: slope.	Moderate: too clayey.	Severe: slope.	Poor: slope.
BfD*:					
Buse	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
Forman	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: slope, too clayey.
Aastad	Severe: floods, wetness, percs slowly.	Slight	Severe: floods, wetness.	Severe: floods.	Fair: too clayey.
Da: Divide	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy, small stones, seepage.
Db: Dovray	Severe: percs slowly, wetness, floods.	Slight	Severe: wetness, too clayey, floods.	Severe: wetness, floods.	Poor: wetness, too clayey.
EaA, EaB: Egeland	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
Ec: Estelline	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: thin layer.
Fa: Flom	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
FbA: Fordville	Slight	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: small stones, too sandy, seepage.
FcB*:					
Fordville	Slight	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: small stones, too sandy, seepage.
Renshaw	Slight	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, small stones.
FdA*:					
Forman	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
Aastad	Severe: floods, wetness, percs slowly.	Slight	Severe: floods, wetness.	Severe: floods.	Fair: too clayey.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
FdB*:					
Forman	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Aastad	Severe: floods, wetness, percs slowly.	Slight	Severe: floods, wetness.	Severe: floods.	Fair: too clayey.
FdC*:					
Forman	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Aastad	Severe: floods, wetness, percs slowly.	Slight	Severe: floods, wetness.	Severe: floods.	Fair: too clayey.
FdD*:					
Forman	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: slope, too clayey.
Aastad	Severe: floods, wetness, percs slowly.	Slight	Severe: floods, wetness.	Severe: floods.	Fair: too clayey.
FeC*:					
Forman	Severe: percs slowly, large stones.	Severe: large stones.	Severe: large stones.	Slight	Poor: large stones.
Aastad	Severe: floods, wetness, percs slowly.	Slight	Severe: floods, wetness.	Severe: floods.	Fair: too clayey.
FgC*:					
Forman	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Buse	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
FgE*:					
Forman	Severe: percs slowly, slope.	Severe: slope.	Moderate: too clayey.	Severe: slope.	Poor: slope.
Buse	Severe: percs slowly, slope.	Severe: slope.	Moderate: too clayey.	Severe: slope.	Poor: slope.
FhE*:					
Forman	Severe: percs slowly, large stones, slope.	Severe: slope, large stones, slope.	Severe: large stones.	Severe: slope.	Poor: large stones, slope.
Buse	Severe: percs slowly, slope, large stones.	Severe: slope, large stones.	Severe: large stones.	Severe: slope.	Poor: slope, large stones.
HaD Hattie	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
HaE: Hattie	Severe: slope, percs slowly.	Severe: slope.	Severe: too clayey.	Severe: slope.	Poor: too clayey, slope.
HbB*:					
Heimdal	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
Sisseton	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
HbC*:					
Heimdal	Slight	Severe: slope, seepage.	Severe: seepage.	Severe: seepage.	Good.
Sisseton	Slight	Severe: slope.	Slight	Slight	Good.
HcA*, HcB*:					
Heimdal	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
Svea	Severe: percs slowly, floods.	Slight	Severe: wetness, floods.	Severe: floods.	Fair: too clayey.
La, Lb: LaDelle	Severe: floods.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Fair: too clayey.
Lc: Ludden	Severe: percs slowly, floods, wetness.	Slight	Severe: too clayey, floods, wetness.	Severe: wetness, floods.	Poor: too clayey, wetness.
MaE: Maddock	Severe: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage, slope.	Poor: too sandy, slope, seepage.
Mb: Marysland	Severe: wetness.	Severe: wetness, seepage.	Severe: wetness, seepage, too sandy.	Severe: wetness, seepage.	Poor: wetness, too sandy, seepage.
Oa: Overly	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
Pa: Parnell	Severe: floods, wetness, percs slowly.	Slight	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: wetness, too clayey.
Pb: Parnell	Severe: floods, wetness, percs slowly.	Slight	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: wetness, too clayey.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
PcA: Peever	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey.
PcB: Peever	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
PcC: Peever	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Slight	Poor: too clayey.
Pd*:					
Peever	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey.
Cavour	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Poor: excess sodium.
Pe*:					
Peever	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey.
Tonka	Severe: wetness, floods, percs slowly.	Severe: wetness, floods.	Severe: wetness, floods, too clayey.	Severe: wetness, floods.	Poor: too clayey, wetness.
Ph: Playmoor	Severe: floods, wetness, percs slowly.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
Po: Poinsett	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Fair: too clayey.
Ra: Rauville	Severe: floods, wetness, percs slowly.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Poor: wetness.
RbA, RbB: Renshaw	Slight	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, small stones.
RcD*:					
Renshaw	Moderate: slope.	Severe: slope, seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, small stones.
Sioux	Moderate: slope.	Severe: slope, seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: small stones, seepage.
RdE*:					
Renshaw	Severe: slope.	Severe: slope, seepage.	Severe: seepage, too sandy.	Severe: seepage, slope.	Poor: too sandy, slope, small stones.
Sioux	Severe: slope.	Severe: slope, seepage.	Severe: seepage, too sandy, slope.	Severe: slope, seepage.	Poor: slope, large stones, seepage.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
ReA: Rentill	Severe: percs slowly.	Severe: seepage.	Severe: too clayey.	Severe: seepage.	Poor: too clayey.
SaE*:					
Sioux	Severe: slope.	Severe: slope, seepage.	Severe: slope, seepage, too sandy.	Severe: slope, seepage.	Poor: slope, small stones, seepage.
Renshaw	Severe: slope.	Severe: slope, seepage.	Severe: seepage, too sandy.	Severe: seepage, slope.	Poor: too sandy, slope, small stones.
SbE: Sisseton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
ScD*:					
Sisseton	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
Heimdal	Moderate: slope.	Severe: slope, seepage.	Severe: seepage.	Severe: seepage.	Fair: slope.
Sd: Svea	Severe: percs slowly, floods.	Slight	Severe: wetness, floods.	Severe: floods.	Fair: too clayey.
SeA: Swenoda	Severe: percs slowly.	Severe: seepage, wetness.	Moderate: wetness, too clayey.	Severe: seepage.	Fair: wetness.
Ta: Tonka	Severe: wetness, floods, percs slowly.	Slight	Severe: wetness, floods, too clayey.	Severe: wetness, floods.	Poor: too clayey, wetness.
Va: Vallers	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Vb*:					
Vallers	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Parnell	Severe: floods, wetness, percs slowly.	Slight	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: wetness, too clayey.
Vc*:					
Vallers	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Tonka	Severe: wetness, floods, percs slowly.	Slight	Severe: wetness, floods, too clayey.	Severe: wetness, floods.	Poor: too clayey, wetness.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
VdD*:					
Vienna	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
Buse	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
VeA*:					
Vienna	Severe: percs slowly.	Slight	Moderate. too clayey.	Slight	Fair: too clayey.
Lismore	Severe: floods, wetness, percs slowly.	Slight	Severe: floods.	Severe: floods.	Fair: too clayey.
VeB*:					
Vienna	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	
Lismore	Severe: floods, wetness, percs slowly.	Slight	Severe: floods.	Severe: floods.	Fair: too clayey.
VeC*:					
Vienna	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Lismore	Severe: floods, wetness, percs slowly.	Slight	Severe: floods.	Severe: floods.	Fair: too clayey.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and "poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Aa*:				
Aastad	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Flom	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
AbA, AbB, AbC Arvilla	Good	Good	Good	Poor: area reclaim.
BaE*:				
Barnes	Fair: low strength, shrink-swell, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Buse	Fair: low strength, large stones, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: large stones, slope.
BbB*, BbC*:				
Barnes	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Svea	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
BbD*:				
Barnes	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
Svea	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Bc Bearden	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, excess salt.
Bd Brookings	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
BeF*:				
Buse	Poor: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Forman	Fair: shrink-swell, low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
BfD*:				
Buse	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
Forman	Fair: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, slope.
Aastad	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Da------- Divide	Good	Fair: excess fines.	Fair: excess fines.	Fair: thin layer.
Db------- Dovray	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey, wetness.
EaA, EaB------- Egeland	Good	Poor: excess fines.	Unsuited: excess fines.	Good.
Ec------- Estelline	Good	Good	Good	Fair: too clayey.
Fa------- Flom	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
FbA------- Fordville	Good	Good	Good	Fair: area reclaim.
FcB*:				
Fordville-------	Good	Good	Good	Fair: area reclaim.
Renshaw-------	Good	Good	Good	Poor: thin layer, area reclaim.
FdA*, FdB*, FdC*:				
Forman-------	Fair: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Aastad-------	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
FdD*:				
Forman-------	Fair: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, slope.
Aastad-------	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
FeC*:				
Forman-------	Fair: low strength, large stones, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: large stones.
Aastad-------	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
FgC*:				
Forman-------	Fair: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Buse-------	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
FgE*:				
Forman-------	Fair: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
FgE*:				
Buse	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
FhE*:				
Forman	Fair: low strength, large stones, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: large stones.
Buse	Fair: low strength, large stones, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: large stones, slope.
HaD Hattie	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
HaE Hattie	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey, slope.
HbB*, HbC*:				
Heimdal	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
Sisseton	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
HcA*, HcB*:				
Heimdal	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
Svea	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
La, Lb LaDelle	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Lc Ludden	Poor: shrink-swell, wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey, wetness.
MaE Maddock	Fair: slope.	Fair: excess fines.	Unsuited: excess fines.	Poor: slope.
Mb Marysland	Poor: wetness.	Fair: excess fines.	Unsuited: excess fines.	Poor: wetness.
Oa Overly	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
Pa Parnell	Poor: wetness, low strength, frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey, wetness.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Pb: Parnell	Poor: low strength, wetness, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
PcA, PcB, PcC: Peever	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer.
Pd*:				
Peever	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer.
Cavour	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: excess salt, excess sodium.
Pe*:				
Peever	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer.
Tonka	Poor: wetness, low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
Ph: Playmoor	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: excess salt, wetness.
Po: Poinsett	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Ra: Rauville	Poor: low strength, wetness.	Poor: excess fines.	Unsuited: excess fines.	Poor: wetness.
RbA, RbB: Renshaw	Good	Good	Good	Poor: thin layer, area reclaim.
RcD*:				
Renshaw	Good	Good	Good	Poor: thin layer, area reclaim.
Sioux	Good	Good	Good	Poor: small stones, area reclaim.
RdE*:				
Renshaw	Fair: slope.	Good	Good	Poor: slope, thin layer, area reclaim.
Sioux	Fair: slope.	Good	Good	Poor: slope, small stones.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
ReA------------------- Rentill	Poor: shrink-swell, low strength.	Poor: excess fines.	Unsuited: excess fines.	Poor: thin layer.
SaE*:				
Sioux-----------------	Poor: slope.	Good-----------------	Good-----------------	Poor: slope, small stones, area reclaim.
Renshaw---------------	Poor: slope.	Good-----------------	Good-----------------	Poor: slope, thin layer, area reclaim.
SbE------------------- Sisseton	Poor: slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
ScD*:				
Sisseton--------------	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
Heimdal---------------	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Fair: slope.
Sd-------------------- Svea	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
SeA------------------- Swenoda	Poor: low strength.	Poor: excess fines, thin layer.	Unsuited: excess fines.	Good.
Ta-------------------- Tonka	Poor: wetness, low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
Va-------------------- Vallers	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Vb*:				
Vallers---------------	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Parnell---------------	Poor: wetness, low strength, frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey, wetness.
Vc*:				
Vallers---------------	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Tonka-----------------	Poor: wetness, low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
VdD*:				
Vienna	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, thin layer.
Buse	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
VeA*, VeB*, VeC*:				
Vienna	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Lismore	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Aa*:						
Aastad	Favorable	Favorable	Not needed	Floods	Not needed	Favorable.
Flom	Favorable	Wetness	Frost action	Wetness	Not needed	Wetness.
AbA Arvilla	Seepage	Seepage	Not needed	Droughty, soil blowing.	Not needed	Droughty.
AbB Arvilla	Seepage	Seepage	Not needed	Droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
AbC Arvilla	Seepage, slope.	Seepage	Not needed	Slope, droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
BaE*:						
Barnes	Slope, seepage.	Favorable	Not needed	Slope, large stones.	Slope, large stones.	Slope, large stones.
Buse	Slope	Large stones	Not needed	Large stones, slope.	Slope, large stones.	Slope, large stones.
BbB*:						
Barnes	Seepage	Favorable	Not needed	Favorable	Favorable	Favorable.
Svea	Seepage	Favorable	Not needed	Floods	Not needed	Favorable.
BbC*:						
Barnes	Slope	Favorable	Not needed	Slope	Favorable	Favorable.
Svea	Seepage	Favorable	Not needed	Floods	Not needed	Favorable.
BbD*:						
Barnes	Slope	Favorable	Not needed	Slope	Slope	Slope.
Svea	Seepage	Favorable	Not needed	Floods	Not needed	Favorable.
Bc Bearden	Favorable	Wetness	Percs slowly, frost action, excess salt.	Wetness, percs slowly.	Not needed	Percs slowly.
Bd Brookings	Favorable	Favorable	Not needed	Floods	Not needed	Favorable.
BeF*:						
Buse	Slope	Favorable	Not needed	Slope	Slope	Slope, erodes easily.
Forman	Slope	Favorable	Not needed	Slope	Slope	Slope.
BfD*:						
Buse	Slope	Favorable	Not needed	Slope	Slope	Slope, erodes easily.
Forman	Slope	Favorable	Not needed	Slope	Slope	Slope.
Aastad	Favorable	Favorable	Not needed	Floods	Not needed	Favorable.
Da Divide	Seepage	Seepage	Favorable	Wetness	Not needed	Favorable.
Db Dovray	Favorable	Hard to pack, wetness.	Percs slowly, floods.	Wetness, slow intake, percs slowly.	Not needed	Wetness, percs slowly.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
EaA---------------- Egeland	Seepage--------	Piping, seepage.	Not needed-----	Soil blowing---	Not needed-----	Favorable.
EaB---------------- Egeland	Seepage--------	Piping, seepage.	Not needed-----	Soil blowing---	Soil blowing---	Favorable.
Ec----------------- Estelline	Seepage--------	Seepage--------	Not needed-----	Favorable------	Not needed-----	Favorable.
Fa----------------- Flom	Favorable------	Wetness--------	Frost action---	Wetness--------	Not needed-----	Wetness.
FbA---------------- Fordville	Seepage--------	Seepage--------	Not needed-----	Favorable------	Not needed-----	Favorable.
FcB*:						
Fordville---------	Seepage--------	Seepage--------	Not needed-----	Favorable------	Too sandy------	Favorable.
Renshaw-----------	Seepage--------	Seepage--------	Not needed-----	Droughty-------	Too sandy------	Droughty.
FdA*:						
Forman------------	Favorable------	Favorable------	Not needed-----	Favorable------	Not needed-----	Favorable.
Aastad------------	Favorable------	Favorable------	Not needed-----	Floods---------	Not needed-----	Favorable.
FdB*:						
Forman------------	Favorable------	Favorable------	Not needed-----	Favorable------	Favorable------	Erodes easily.
Aastad------------	Favorable------	Favorable------	Not needed-----	Floods---------	Not needed-----	Favorable.
FdC*:						
Forman------------	Slope----------	Favorable------	Not needed-----	Slope----------	Favorable------	Erodes easily.
Aastad------------	Favorable------	Favorable------	Not needed-----	Floods---------	Not needed-----	Favorable.
FdD*:						
Forman------------	Slope----------	Favorable------	Not needed-----	Slope----------	Slope----------	Slope.
Aastad------------	Favorable------	Favorable------	Not needed-----	Floods---------	Not needed-----	Favorable.
FeC*:						
Forman------------	Favorable------	Large stones	Not needed-----	Large stones---	Large stones---	Large stones, erodes easily.
Aastad------------	Favorable------	Favorable------	Not needed-----	Floods---------	Not needed-----	Favorable.
FgC*:						
Forman------------	Slope----------	Favorable------	Not needed-----	Slope----------	Favorable------	Erodes easily.
Buse--------------	Slope----------	Favorable------	Not needed-----	Slope----------	Favorable------	Erodes easily.
FgE*:						
Forman------------	Slope----------	Favorable------	Not needed-----	Slope----------	Slope----------	Slope.
Buse--------------	Slope----------	Favorable------	Not needed-----	Slope----------	Slope----------	Slope, erodes easily.
FhE*:						
Forman------------	Slope----------	Large stones	Not needed-----	Slope, large stones.	Slope, large stones.	Slope, large stones, erodes easily.
Buse--------------	Slope----------	Large stones	Not needed-----	Large stones, slope.	Slope, large stones.	Slope, large stones.
HaD, HaE---------- Hattie	Slope----------	Hard to pack	Not needed-----	Slope, slow intake, percs slowly.	Slope, percs slowly.	Slope, percs slowly.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
HbB*:						
Heimdal	Seepage	Piping	Not needed	Favorable	Too sandy	Erodes easily.
Sisseton	Seepage	Piping	Not needed	Favorable	Favorable	Erodes easily.
HbC*:						
Heimdal	Seepage, slope.	Piping	Not needed	Slope	Too sandy	Erodes easily.
Sisseton	Seepage, slope.	Piping	Not needed	Slope, erodes easily.	Favorable	Erodes easily.
HcA*:						
Heimdal	Seepage	Piping	Not needed	Favorable	Not needed	Favorable.
Svea	Seepage	Favorable	Not needed	Floods	Not needed	Favorable.
HcB*:						
Heimdal	Seepage	Piping	Not needed	Favorable	Too sandy	Erodes easily.
Svea	Seepage	Favorable	Not needed	Floods	Not needed	Favorable.
La, Lb LaDelle	Seepage	Favorable	Not needed	Floods	Not needed	Favorable.
Lc Ludden	Favorable	Wetness, hard to pack.	Percs slowly, floods, frost action.	Percs slowly, wetness, slow intake.	Not needed	Wetness, percs slowly.
MaE Maddock	Slope, seepage.	Seepage, piping.	Not needed	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
Mb Marysland	Seepage	Seepage, wetness.	Frost action	Wetness	Not needed	Wetness.
Oa Overly	Favorable	Favorable	Not needed	Percs slowly	Not needed	Percs slowly.
Pa Parnell	Favorable	Hard to pack, wetness.	Floods, percs slowly, frost action.	Wetness, slow intake, percs slowly.	Not needed	Wetness, percs slowly.
Pb Parnell	Favorable	Hard to pack, wetness.	Percs slowly, floods, frost action.	Wetness, slow intake, floods.	Not needed	Wetness, percs slowly.
PcA Peever	Favorable	Hard to pack	Not needed	Percs slowly	Not needed	Percs slowly.
PcB Peever	Favorable	Hard to pack	Not needed	Percs slowly	Percs slowly	Percs slowly.
PcC Peever	Slope	Hard to pack	Not needed	Slope, percs slowly.	Percs slowly	Percs slowly, erodes easily.
Pd*:						
Peever	Favorable	Hard to pack	Not needed	Percs slowly	Not needed	Percs slowly.
Cavour	Favorable	Hard to pack, piping.	Not needed	Percs slowly, excess sodium.	Not needed	Excess sodium, excess salt.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Pe*:						
Peever	Favorable	Hard to pack	Not needed	Percs slowly	Not needed	Percs slowly.
Tonka	Favorable	Hard to pack, wetness.	Frost action, percs slowly, floods.	Wetness, percs slowly, floods.	Not needed	Wetness, percs slowly.
Ph: Playmoor	Favorable	Wetness, hard to pack.	Excess salt, floods, frost action.	Excess salt, wetness, floods.	Not needed	Excess salt, wetness.
Po: Poinsett	Seepage	Favorable	Not needed	Favorable	Not needed	Erodes easily.
Ra: Rauville	Seepage	Wetness, hard to pack.	Floods, frost action.	Floods, wetness.	Not needed	Wetness.
RbA: Renshaw	Seepage	Seepage	Not needed	Droughty	Not needed	Droughty.
RbB: Renshaw	Seepage	Seepage	Not needed	Droughty	Too sandy	Droughty.
RcD*:						
Renshaw	Seepage, slope.	Seepage	Not needed	Slope, droughty.	Too sandy	Droughty, slope.
Sioux	Seepage, slope.	Seepage	Not needed	Droughty, fast intake, slope.	Too sandy	Slope, droughty.
RdE*:						
Renshaw	Seepage, slope.	Seepage	Not needed	Slope, droughty.	Too sandy, slope.	Droughty, slope.
Sioux	Seepage, slope.	Seepage	Not needed	Large stones, droughty, fast intake.	Large stones, too sandy, slope.	Large stones, droughty, slope.
ReA: Rentill	Seepage	Hard to pack	Not needed	Percs slowly	Not needed	Percs slowly.
SaE*:						
Sioux	Seepage, slope.	Seepage	Not needed	Droughty, fast intake, slope.	Slope, too sandy.	Slope, droughty.
Renshaw	Seepage, slope.	Seepage	Not needed	Slope, droughty.	Too sandy, slope.	Droughty, slope.
SbE: Sisseton	Seepage, slope.	Piping	Not needed	Slope	Slope, erodes easily.	Slope, erodes easily.
ScD*:						
Sisseton	Seepage, slope.	Piping	Not needed	Slope	Slope	Slope.
Heimdal	Seepage, slope.	Piping	Not needed	Slope	Slope, too sandy.	Slope, erodes easily.
Sd: Svea	Seepage	Favorable	Not needed	Floods	Not needed	Favorable.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
SeA Swenoda	Seepage	Wetness	Favorable	Soil blowing	Not needed	Favorable.
Ta Tonka	Favorable	Hard to pack, wetness.	Frost action, percs slowly, floods.	Wetness, percs slowly, floods.	Not needed	Wetness, percs slowly.
Va Vallers	Favorable	Wetness	Frost action	Wetness	Not needed	Wetness.
Vb*:						
Vallers	Favorable	Wetness	Frost action	Wetness	Not needed	Wetness.
Parnell	Favorable	Hard to pack, wetness.	Floods, percs slowly, frost action.	Wetness, slow intake, percs slowly.	Not needed	Wetness, percs slowly.
Vc*:						
Vallers	Favorable	Wetness	Frost action	Wetness	Not needed	Wetness.
Tonka	Favorable	Hard to pack, wetness.	Frost action, percs slowly, floods.	Wetness, percs slowly, floods.	Not needed	Wetness, percs slowly.
VdD*:						
Vienna	Slope	Favorable	Not needed	Slope	Slope	Slope.
Buse	Slope	Favorable	Not needed	Slope	Slope	Slope.
VeA*:						
Vienna	Favorable	Favorable	Not needed	Favorable	Not needed	Favorable.
Lismore	Favorable	Favorable	Not needed	Floods	Not needed	Favorable.
VeB*:						
Vienna	Favorable	Favorable	Not needed	Favorable	Favorable	Favorable.
Lismore	Favorable	Favorable	Not needed	Floods	Not needed	Favorable.
VeC*:						
Vienna	Slope	Favorable	Not needed	Slope	Favorable	Favorable.
Lismore	Favorable	Favorable	Not needed	Floods	Not needed	Favorable.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Aa*:											
Aastad	0-17	Loam	ML, CL	A-6, A-7	0-5	95-100	95-100	80-95	50-75	35-45	10-20
	17-29	Clay loam	CL	A-7, A-6	0-5	95-100	90-100	75-95	50-75	35-50	10-25
	29-60	Clay loam, loam	CL	A-6, A-7	0-5	90-100	85-100	75-95	55-75	35-50	12-25
Flom	0-17	Clay loam	OL, CL-ML, CL	A-4, A-6, A-7	0	95-100	95-100	80-100	60-90	20-50	5-20
	17-25	Clay loam, silty clay loam.	CL	A-6, A-7	0	95-100	95-100	90-100	70-95	30-50	10-30
	25-60	Loam, clay loam, silty clay loam.	CL	A-6, A-7	0	95-100	95-100	80-95	60-90	20-50	10-30
AbA, AbB, AbC Arvilla	0-7	Sandy loam	SM, SC, SM-SC	A-2, A-4	0	100	100	60-80	30-45	10-30	NP-10
	7-16	Coarse sandy loam, sandy loam.	SM, SC, SM-SC	A-2, A-4	0	95-100	90-100	60-70	30-40	10-30	NP-10
	16-60	Sand and gravel, gravelly sand.	SP-SM, GP, SP, GP-GM	A-1	0	35-95	25-80	10-50	0-10	---	NP
BaE*:											
Barnes	0-5	Extremely stony loam.	CL, ML, CL-ML	A-4, A-6	10-70	90-100	85-95	70-90	55-80	30-40	5-15
	5-13	Loam, clay loam	CL, CL-ML	A-4, A-6	0-20	95-100	90-100	80-95	60-80	25-40	5-15
	13-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-15	95-100	90-100	80-95	60-80	25-40	5-15
Buse	0-7	Extremely stony loam.	ML, CL	A-4, A-6	10-70	90-100	85-95	70-90	55-80	30-40	5-15
	7-60	Loam, clay loam	CL	A-4, A-6	5-30	90-100	85-95	70-90	60-80	25-40	8-15
BbB*, BbC*, BbD*:											
Barnes	0-5	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	85-100	60-90	20-40	5-15
	5-13	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	55-80	25-40	5-15
	13-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	55-80	25-40	5-15
Svea	0-13	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-95	60-90	20-40	5-15
	13-28	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-95	60-90	20-45	5-25
	28-60	Stratified sandy loam to clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-95	60-90	20-50	5-30
Bc Bearden	0-7	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	80-95	30-50	10-25
	7-31	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	30-50	10-25
	31-60	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	30-50	10-25
Bd Brookings	0-12	Silt loam	CL, ML	A-6, A-7	0	100	100	95-100	85-100	30-45	15-25
	12-25	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	15-25
	25-60	Loam, clay loam	CL	A-6, A-7	0	100	95-100	85-100	70-85	35-50	15-25
BeF*:											
Buse	0-7	Loam	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	55-80	20-40	3-20
	7-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	60-80	25-40	5-20

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
BeF*:											
Forman	0-6	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	85-100	60-90	20-40	5-15
	6-23	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-80	25-40	5-15
	23-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-80	25-40	5-15
BfD*:											
Buse	0-7	Loam	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	55-80	20-40	3-20
	7-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	60-80	25-40	5-20
Forman	0-6	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	85-100	60-90	20-40	5-15
	6-23	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-80	25-40	5-15
	23-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-80	25-40	5-15
Aastad	0-17	Loam	ML, CL	A-6, A-7	0-5	95-100	95-100	80-95	50-75	35-45	10-20
	17-29	Clay loam	CL	A-7, A-6	0-5	95-100	90-100	75-95	50-75	35-50	10-25
	29-60	Clay loam, loam	CL	A-6, A-7	0-5	90-100	85-100	75-95	55-75	35-50	12-25
Da: Divide	0-7	Loam	CL, ML, CL-ML	A-4, A-6	0	95-100	95-100	85-95	60-85	25-40	5-20
	7-23	Loam, clay loam, gravelly loam.	CL, ML, CL-ML	A-4, A-6	0-3	95-100	80-100	60-90	55-80	25-40	5-20
	23-60	Stratified loamy sand to gravelly sand.	GM, SM, GP-GM, SP-SM	A-1	0-5	25-80	15-70	10-40	5-35	---	NP
Db: Dovray	0-21	Silty clay	CH, MH, OH	A-7	0	100	100	95-100	85-95	50-75	25-40
	21-41	Clay, silty clay	CH, MH	A-7	0	100	95-100	90-100	85-95	50-80	25-40
	41-60	Clay, silty clay loam, clay loam.	CH, MH, CL	A-7	0	100	95-100	80-100	70-95	40-75	20-40
EaA, EaB: Egeland	0-8	Sandy loam	SM, SM-SC, SC	A-2, A-4	0	100	95-100	75-100	30-50	20-30	NP-10
	7-30	Sandy loam, fine sandy loam.	SM, SM-SC, SC	A-2, A-4	0	95-100	85-100	70-95	15-50	15-30	NP-10
	30-60	Loamy sand, loamy fine sand.	SM, SP-SM	A-2	0	95-100	85-100	70-90	10-35	<25	NP-5
Ec: Estelline	0-8	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-100	35-50	11-25
	8-24	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	11-25
	24-60	Sand and gravel	SW, SP, GP, SP-SM	A-1	0-5	70-100	45-70	10-30	0-10	<25	NP-5
Fa: Flom	0-17	Clay loam	OL, CL-ML, CL	A-4, A-6, A-7	0	95-100	95-100	80-100	60-90	20-50	5-20
	17-25	Clay loam, silty clay loam.	CL	A-6, A-7	0	95-100	95-100	90-100	70-95	30-50	10-30
	25-60	Loam, clay loam, silty clay loam.	CL	A-6, A-7	0	95-100	95-100	80-95	60-90	20-50	10-30
FbA: Fordville	0-7	Loam	ML, CL	A-4, A-6, A-7	0	100	100	70-85	55-75	30-45	5-20
	7-24	Loam, silt loam, clay loam.	CL, ML	A-4, A-6, A-7	0	100	95-100	70-95	55-80	30-45	5-15
	24-60	Sand and gravel	SW, GP, SP, SP-SM	A-1	0	65-85	45-70	15-40	0-10	<25	NP-5

See footnote at end of table.

TABLE 4.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
FcB*:											
Fordville	0-7	Loam	ML, CL	A-4, A-6, A-7	0	100	100	70-85	55-75	30-45	5-20
	7-24	Loam, silt loam, clay loam.	CL, ML	A-4, A-6, A-7	0	100	95-100	70-95	55-80	30-45	5-15
	24-60	Sand and gravel	SW, GP, SP, SP-SM	A-1	0	65-85	45-70	15-40	0-10	<25	NP-5
Renshaw	0-18	Loam	ML, CL	A-4, A-6	0-5	95-100	90-100	70-100	50-75	30-40	5-15
	18-60	Sand and gravel	SW, SM, GW, GW-GM	A-1	0-5	45-95	40-70	10-50	0-15	<25	NP-5
FdA*, FdB*, FdC*, FdD*:											
Forman	0-6	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	85-100	60-90	20-40	5-15
	6-23	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-80	25-40	5-15
	23-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-80	25-40	5-15
Aastad	0-17	Loam	ML, CL	A-6, A-7	0-5	95-100	95-100	80-95	50-75	35-45	10-20
	17-29	Clay loam	CL	A-7, A-6	0-5	95-100	90-100	75-95	50-75	35-50	10-25
	29-60	Clay loam, loam	CL	A-6, A-7	0-5	90-100	85-100	75-95	55-75	35-50	12-25
FeC*:											
Forman	0-6	Extremely stony loam.	CL, ML	A-4, A-6	10-70	95-100	90-100	80-95	60-80	30-40	5-15
	6-23	Loam, clay loam	CL	A-4, A-6, A-7	0-20	95-100	90-100	80-95	60-80	30-45	8-20
	23-60	Loam, clay loam	CL	A-4, A-6, A-7	0-20	95-100	90-100	80-95	60-80	30-45	8-20
Aastad	0-17	Loam	ML, CL	A-6, A-7	0-5	95-100	95-100	80-95	50-75	35-45	10-20
	17-29	Clay loam	CL	A-7	0-5	95-100	90-100	75-95	50-75	40-50	15-25
	29-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	85-100	75-95	55-75	35-50	12-25
FgC*, FgE*:											
Forman	0-6	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	85-100	60-90	20-40	5-15
	6-23	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-80	25-40	5-15
	23-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-80	25-40	5-15
Buse	0-7	Loam	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	55-80	20-40	3-20
	7-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	60-80	25-40	5-20
FhE*:											
Forman	0-6	Extremely stony loam.	CL, ML	A-4, A-6	10-70	95-100	90-100	80-95	60-80	30-40	5-15
	6-16	Loam, clay loam	CL	A-4, A-6, A-7	0-20	95-100	90-100	80-95	60-80	30-45	8-20
	16-60	Loam, clay loam	CL	A-4, A-6, A-7	0-20	95-100	90-100	80-95	60-80	30-45	8-20
Buse	0-7	Extremely stony loam.	ML, CL	A-4, A-6	10-70	90-100	85-95	70-90	55-80	30-40	5-15
	7-60	Loam, clay loam	CL	A-4, A-6	5-30	90-100	85-95	70-90	60-80	25-40	8-15

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
HaD, HaE----------- Hattie	0-7	Clay loam-------	CL, CH	A-7	0	95-100	90-97	75-95	70-90	40-55	15-30
	7-60	Clay, silty clay	CH	A-7	0	95-100	90-97	75-95	70-90	50-70	23-43
HbB*, HbC*:											
Heimdal-----------	0-8	Loam------------	ML	A-4	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	8-22	Loam------------	ML	A-4	0-1	95-100	95-100	85-95	60-75	20-40	NP-10
	22-60	Loam, silt, fine sand.	ML, SM	A-4, A-2	0-5	95-100	95-100	65-100	30-90	20-40	NP-10
Sisseton----------	0-7	Loam------------	ML, CL	A-4, A-6	0-5	95-100	90-100	90-100	60-75	25-35	3-11
	7-35	Loam, silt loam	ML, CL	A-4, A-6	0-5	90-100	85-100	75-100	60-90	25-35	3-11
	35-60	Stratified silt loam to sandy loam.	ML, CL, CL-ML	A-4, A-6	0-5	90-100	85-100	70-95	50-75	20-35	3-11
HcA*, HcB*:											
Heimdal-----------	0-8	Loam------------	ML	A-4	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	8-22	Loam------------	ML	A-4	0-1	95-100	95-100	85-95	60-75	20-40	NP-10
	22-60	Loam, silt, fine sand.	ML, SM	A-4, A-2	0-5	95-100	95-100	65-100	30-90	20-40	NP-10
Svea--------------	0-13	Loam------------	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-95	60-90	20-40	5-15
	13-28	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-95	60-90	20-45	5-25
	28-60	Stratified sandy loam to clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-95	60-90	20-50	5-30
La, Lb------------- LaDelle	0-18	Silt loam-------	ML, CL	A-4, A-6, A-7	0	100	100	90-100	75-100	30-45	5-20
	18-60	Silt loam, silty clay loam, loam.	CL, CL-ML, ML, MH	A-4, A-6, A-7	0	100	100	90-100	75-100	25-55	5-25
Lc----------------- Ludden	0-38	Silty clay------	CH, MH	A-7	0	100	100	95-100	75-95	50-75	25-50
	38-60	Silty clay, clay	CH, MH	A-7	0	100	100	95-100	75-95	50-75	25-50
MaE---------------- Maddock	0-14	Loamy fine sand	SM	A-2	0	100	100	50-80	15-35	---	NP
	14-60	Loamy sand, loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	60-95	5-35	---	NP
Mb----------------- Marysland	0-15	Loam------------	CL	A-6, A-7	0	95-100	95-100	85-95	50-80	30-50	10-25
	15-38	Loam, clay loam, sandy clay loam.	CL, SC	A-6	0	90-100	85-100	80-95	45-80	20-40	10-20
	38-60	Stratified fine sand to gravelly coarse sand.	SP-SM, SM	A-1, A-2, A-3	0	70-95	50-90	35-70	5-20	---	NP
Oa----------------- Overly	0-12	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	80-95	30-45	10-25
	12-42	Silty clay loam, silt loam, clay loam.	CL, CL-ML	A-6, A-7, A-4	0	100	100	90-100	80-95	25-50	5-30
	42-60	Stratified silt loam to silty clay.	CL, CL-ML	A-6, A-7, A-4	0	100	100	90-100	80-95	25-50	5-30

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Pa----------------- Parnell	0-11	Silty clay loam	CL, CH	A-7	0	100	100	95-100	85-95	40-60	15-20
	11-54	Clay loam, silty clay loam, silty clay.	CL, CH	A-7	0	100	95-100	90-100	70-95	40-80	20-50
	54-60	Clay loam, silty clay loam, silty clay.	CL, CH	A-6, A-7	0	95-100	90-100	80-95	70-95	30-80	15-50
Pb----------------- Parnell	0-11	Silty clay loam	CL, CH	A-7	0	100	100	95-100	85-95	40-60	15-30
	11-54	Clay loam, silty clay loam, silty clay.	CH, MH	A-7	0	100	95-100	90-100	70-95	50-80	20-45
	54-60	Clay loam, silty clay loam, silty clay.	CL, CH	A-6, A-7	0	95-100	90-100	80-95	70-95	35-80	15-45
PcA, PcB, PcC------ Peever	0-9	Clay loam-------	CL	A-6, A-7	0	100	95-100	90-100	65-90	35-50	12-25
	9-42	Clay, silty clay, clay loam.	CL, CH, MH, ML	A-7	0	100	95-100	85-100	70-95	40-65	15-30
	42-60	Clay loam, clay	CL, CH, MH, ML	A-7	0-5	95-100	95-100	85-100	70-95	40-70	15-35
Pd*:											
Peever------------	0-9	Clay loam-------	CL	A-6, A-7	0	100	95-100	90-100	65-90	35-50	12-25
	9-42	Clay, silty clay, clay loam.	CL, CH, MH, ML	A-7	0	100	95-100	85-100	70-95	40-65	15-30
	42-60	Clay loam, clay	CL, CH, MH, ML	A-7	0-5	95-100	95-100	85-100	70-95	40-70	15-35
Cavour------------	0-8	Loam------------	ML, CL	A-4, A-6, A-7	0	100	95-100	85-100	60-85	30-45	5-20
	8-27	Clay, clay loam, silty clay loam.	CL, CH	A-7	0	100	95-100	90-100	70-95	40-65	15-35
	27-60	Clay loam, loam	CL, CH	A-7, A-6	0-5	95-100	95-100	85-100	60-85	35-65	12-35
Pe*:											
Peever------------	0-9	Clay loam-------	CL	A-6, A-7	0	100	95-100	90-100	65-90	35-50	12-25
	9-42	Clay, silty clay, clay loam.	CL, CH MH, ML	A-7	0	100	95-100	85-100	70-95	40-65	15-30
	42-60	Clay loam, clay	CL, CH MH, ML	A-7	0-5	95-100	95-100	85-100	70-95	40-70	15-35
Tonka-------------	0-23	Silt loam-------	CL, CL-ML	A-4, A-6	0-2	100	95-100	90-100	70-90	20-40	5-25
	23-42	Silty clay, clay loam, clay.	CH, CL	A-6, A-7	0-2	100	95-100	90-100	75-95	35-55	15-35
	42-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-3	100	95-100	90-100	70-90	20-50	10-30
Ph----------------- Playmoor	0-36	Silty clay loam	CL, CH, MH, ML	A-6, A-7	0	100	100	95-100	80-100	35-60	12-25
	36-60	Silt loam, silty clay loam.	CL, CH, MH, ML	A-6, A-7	0	100	100	90-100	85-100	35-60	12-25

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
Po----------------- Poinsett	0-8	Silt loam-------	CL, ML	A-6, A-7, A-4	0	100	100	90-100	80-100	30-50	5-25
	8-50	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	95-100	95-100	85-100	30-50	10-25
	50-60	Stratified sandy loam to silty clay loam.	CL, ML, SC, SM	A-4, A-6, A-7	0	100	95-100	65-100	45-100	25-50	3-25
Ra----------------- Rauville	0-27	Silty clay loam	CL, CH, MH	A-6, A-7	0	100	100	90-100	85-100	35-60	15-28
	27-45	Silty clay loam, silt loam.	CL, CH, MH	A-6, A-7	0	100	100	90-100	85-100	35-60	15-28
	45-60	Stratified gravelly sand to clay loam.	SM, SC, CL, ML	A-2, A-4	0	80-100	65-95	50-85	15-70	<30	NP-10
RbA, RbB----------- Renshaw	0-18	Loam------------	ML, CL	A-4, A-6	0-5	95-100	90-100	70-100	50-75	30-40	5-15
	18-60	Sand and gravel	SW, SM, GW, GW-GM	A-1	0-5	45-95	40-70	10-50	0-15	<25	NP-5
RcD*:											
Renshaw-----------	0-18	Loam------------	ML, CL	A-4, A-6	0-5	95-100	90-100	70-100	50-75	30-40	5-15
	18-60	Sand and gravel	SW, SM, GW, GW-GM	A-1	0-5	45-95	40-70	10-50	0-15	<25	NP-5
Sioux-------------	0-6	Sandy loam------	SM, SM-SC	A-4	0-5	95-100	85-100	60-85	35-45	20-30	NP-7
	6-12	Gravelly loam, gravelly sandy loam, gravelly loamy sand.	SM, SM-SC	A-4, A-2, A-1	0-5	60-90	50-80	45-70	15-50	20-35	5-10
	12-60	Sand and gravel	GM, GP, SM, SP	A-1	0	25-75	10-60	5-35	0-25	<25	NP-5
RdE*:											
Renshaw-----------	0-18	Loam------------	ML, CL	A-4, A-6	0-5	95-100	90-100	70-100	50-75	30-40	5-15
	18-60	Sand and gravel	SW, SM, GW, GW-GM	A-1	0-5	45-95	40-70	10-50	0-15	<25	NP-5
Sioux-------------	0-6	Extremely stony sandy loam.	ML,CL, SM, SC	A-4, A-6	15-75	75-100	60-90	50-85	35-70	30-40	5-15
	6-12	Gravelly sandy loam.	SM, GM	A-4, A-2, A-1	15-50	60-90	50-80	45-70	15-40	20-30	NP-7
	12-60	Sand and gravel	GM, GP, SM, SP	A-1	0-15	25-75	10-60	5-35	0-25	<25	NP-5
ReA---------------- Rentill	0-16	Loam------------	ML,CL	A-4, A-6	0	100	100	85-95	60-75	30-40	5-15
	16-22	Sand and gravel	SP-SM, SM, SW-SM	A-1, A-2	0-5	60-100	40-90	15-65	5-30	<25	NP-5
	22-60	Clay, clay loam	CL, CH	A-1, A-2, A-3	0	95-100	90-100	85-100	70-95	40-65	15-35

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
SaE*:											
Sioux-------------	0-6	Sandy loam------	SM, SM-SC	A-4	0-5	95-100	85-100	60-85	35-45	20-30	NP-7
	6-12	Gravelly loam, gravelly sandy loam, gravelly loamy sand.	SM, SM-SC	A-4, A-2, A-1	0-5	60-90	50-80	45-70	15-50	20-35	5-10
	12-60	Sand and gravel	GM, GP, SM, SP	A-1	0	25-75	10-60	5-35	0-25	<25	NP-5
Renshaw-----------	0-18	Loam------------	ML, CL	A-4, A-6	0-5	95-100	90-100	70-100	50-75	30-40	5-15
	18-60	Sand and gravel	SW, SM, GW, GW-GM	A-1	0-5	45-95	40-70	10-50	0-15	<25	NP-5
SbE---------------- Sisseton	0-7	Loam------------	ML, CL	A-4, A-6	0-5	95-100	90-100	90-100	60-75	25-35	3-11
	7-35	Loam, silt loam	ML, CL	A-4, A-6	0-5	90-100	85-100	75-100	60-90	25-35	3-11
	35-60	Stratified silt loam to sandy loam.	ML, CL, CL-ML	A-4, A-6	0-5	90-100	85-100	70-95	50-75	20-35	3-11
ScD*:											
Sisseton----------	0-7	Loam------------	ML, CL	A-4, A-6	0-5	95-100	90-100	90-100	60-75	25-35	3-11
	7-35	Loam, silt loam	ML, CL	A-4, A-6	0-5	90-100	85-100	75-100	60-90	25-35	3-11
	35-60	Stratified silt loam to sandy loam.	ML, CL, CL-ML	A-4, A-6	0-5	90-100	85-100	70-95	50-75	20-35	3-11
Heimdal-----------	0-8	Loam------------	ML	A-4	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	8-22	Loam------------	ML	A-4	0-1	95-100	95-100	85-95	60-75	20-40	NP-10
	22-60	Loam, silt, fine sand.	ML, SM	A-4, A-2	0-5	95-100	95-100	65-100	30-90	20-40	NP-10
Sd---------------- Svea	0-13	Loam------------	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-95	60-90	20-40	5-15
	13-28	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-95	60-90	20-45	5-25
	28-60	Stratified sandy loam to clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-95	60-90	20-50	5-30
SeA--------------- Swenoda	0-12	Fine sandy loam	SM, SM-SC	A-2, A-4	0	100	95-100	70-100	30-50	20-30	NP-7
	12-26	Fine sandy loam, sandy loam.	SM-SC, SM, ML, CL-ML	A-2, A-4	0	100	95-100	60-85	30-55	20-30	NP-10
	26-60	Silt loam, loam, clay loam.	CL, ML, CL-ML	A-4, A-6, A-7	0-5	95-100	95-100	75-100	50-95	25-50	5-30
Ta---------------- Tonka	0-23	Silt loam-------	CL, CL-ML	A-4, A-6	0-2	100	95-100	90-100	70-90	20-40	5-25
	23-42	Silty clay, clay loam, clay.	CH, CL	A-6, A-7	0-2	100	95-100	90-100	75-95	35-55	15-35
	42-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-3	100	95-100	90-100	70-90	20-50	10-30
Va---------------- Vallers	0-15	Loam------------	ML	A-4	0	95-100	90-100	80-90	65-80	30-40	4-10
	15-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	95-100	90-97	85-95	60-75	20-40	5-20
Vb*:											
Vallers-----------	0-15	Loam------------	ML	A-4	0	95-100	90-100	80-90	65-80	30-40	4-10
	15-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	95-100	90-97	85-95	60-75	20-40	5-20

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
Vb*:											
Parnell	0-11	Silty clay loam	CH, CL	A-7	0	100	100	95-100	85-95	40-60	15-30
	11-54	Clay loam, silty clay loam, silty clay.	CL, CH	A-7	0	100	95-100	90-100	70-95	40-80	20-50
	54-60	Clay loam, silty clay loam, silty clay.	CL, CH	A-6, A-7	0	95-100	90-100	80-95	70-95	30-80	15-50
Vc*:											
Vallers	0-15	Loam	ML	A-4	0	95-100	90-100	80-90	65-80	30-40	4-10
	15-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	95-100	90-97	85-95	60-75	20-40	5-20
Tonka	0-23	Silt loam	CL, CL-ML	A-4, A-6	0-2	100	95-100	90-100	70-90	20-40	5-25
	23-42	Silty clay, clay loam, clay.	CH, CL	A-6, A-7	0-2	100	95-100	90-100	75-95	35-55	5-35
	42-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-3	100	95-100	90-100	70-90	20-50	10-30
VdD*:											
Vienna	0-10	Silt loam	ML, CL	A-4, A-6, A-7	0	100	100	95-100	85-100	30-45	5-20
	10-15	Silty clay loam, silt loam.	ML, CL	A-6, A-7	0	100	95-100	90-100	85-100	35-50	10-25
	15-28	Clay loam, loam	CL	A-6, A-7	0-5	95-100	90-100	85-100	60-85	30-45	10-20
	28-60	Clay loam, loam	CL	A-6	0-5	90-100	85-100	80-100	55-80	30-40	10-20
Buse	0-7	Loam	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	55-80	20-40	3-20
	7-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	60-80	25-40	5-20
VeA*, VeB*, VeC*:											
Vienna	0-10	Silt loam	ML, CL	A-4, A-6, A-7	0	100	100	95-100	85-100	30-45	5-20
	10-15	Silty clay loam, silt loam.	ML, CL	A-6, A-7	0	100	95-100	90-100	85-100	35-50	10-25
	15-28	Clay loam, loam	CL	A-6, A-7	0-5	95-100	90-100	85-100	60-85	30-45	10-20
	28-60	Clay loam, loam	CL	A-6	0-5	90-100	85-100	80-100	55-80	30-40	10-20
Lismore	0-17	Silt loam	ML, CL	A-6, A-7, A-4	0	100	100	90-100	80-100	30-45	5-20
	17-29	Loam, clay loam	CL	A-6, A-7	0	100	95-100	85-100	70-85	30-50	10-30
	29-60	Loam, clay loam	CL	A-6, A-7	0	100	95-100	85-100	70-85	30-50	10-30

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm				
Aa*:									
Aastad----------	0-17	0.6-2.0	0.18-0.20	6.6-7.8	<2	Moderate	0.24	5	6
	17-29	0.2-0.6	0.15-0.19	6.6-7.8	<2	Moderate	0.32		
	29-60	0.2-0.6	0.14-0.16	7.4-8.4	<2	Moderate	0.32		
Flom------------	0-17	0.2-2.0	0.18-0.24	6.6-7.3	<2	Moderate	0.28	5	6
	17-25	0.2-0.6	0.15-0.19	6.6-8.4	<2	Moderate	0.28		
	25-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.28		
AbA, AbB, AbC---- Arvilla	0-7	2.0-6.0	0.13-0.15	6.1-7.3	<2	Low-------	0.20	3	3
	7-16	2.0-6.0	0.13-0.15	6.6-7.8	<2	Low-------	0.20		
	16-60	>6.0	0.02-0.05	7.4-8.4	<2	Low-------	0.10		
BaE*:									
Barnes----------	0-5	0.6-2.0	0.13-0.24	6.6-7.3	<2	Low-------	0.20	5	6
	5-13	0.6-2.0	0.15-0.19	6.6-7.8	<2	Moderate	0.32		
	13-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.32		
Buse------------	0-7	0.6-2.0	0.18-0.20	6.6-8.4	<2	Moderate	0.28	5	6
	7-60	0.2-0.6	0.16-0.20	7.4-8.4	2-8	Moderate	0.37		
BbB*, BbC*, BbD*:									
Barnes----------	0-5	0.6-2.0	0.13-0.24	6.6-7.8	<2	Low-------	0.28	5	6
	5-13	0.6-2.0	0.15-0.19	6.6-7.8	<4	Moderate	0.28		
	13-60	0.2-0.6	0.14-0.19	7.4-8.4	<8	Moderate	0.37		
Svea------------	0-13	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low-------	0.28	5	6
	13-28	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate	0.28		
	28-60	0.2-2.0	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
Bc-------------- Bearden	0-7	0.2-0.6	0.17-0.23	7.4-8.4	<4	Moderate	0.28	5	4L
	7-31	0.2-2.0	0.16-0.22	7.4-8.4	<8	Moderate	0.28		
	31-60	0.06-2.0	0.16-0.22	7.4-8.4	<8	Moderate	0.43		
Bd-------------- Brookings	0-12	0.6-2.0	0.19-0.22	6.1-7.3	<2	Moderate	0.28	5	6
	12-25	0.6-2.0	0.19-0.22	6.6-7.8	<2	Moderate	0.28		
	25-60	0.2-2.0	0.16-0.20	7.4-8.4	2-8	Moderate	0.43		
BeF*:									
Buse------------	0-7	0.2-2.0	0.17-0.22	6.6-8.4	<2	Moderate	0.28	5	4L
	7-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
Forman----------	0-6	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low-------	0.28	5	6
	6-23	0.6-2.0	0.15-0.19	6.6-7.8	<2	Moderate	0.28		
	23-60	0.06-0.6	0.14-0.19	7.4-8.4	<4	Moderate	0.37		
BfD*:									
Buse------------	0-7	0.2-2.0	0.17-0.22	6.6-8.4	<2	Moderate	0.28	5	4L
	7-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
Forman----------	0-6	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low-------	0.28	5	6
	6-23	0.6-2.0	0.15-0.19	6.6-7.8	<2	Moderate	0.28		
	23-60	0.06-0.6	0.14-0.19	7.4-8.4	<4	Moderate	0.37		
Aastad----------	0-17	0.6-2.0	0.18-0.20	6.6-7.8	<2	Moderate	0.24	5	6
	17-29	0.2-0.6	0.15-0.19	6.6-7.8	<2	Moderate	0.32		
	29-60	0.2-0.6	0.14-0.16	7.4-8.4	<2	Moderate	0.32		
Da-------------- Divide	0-7	0.6-2.0	0.18-0.22	7.9-8.4	<2	Low-------	0.28	4	4L
	7-23	0.6-2.0	0.16-0.19	7.9-8.4	<2	Low-------	0.28		
	23-60	>6.0	0.03-0.07	7.9-8.4	<2	Low-------	0.10		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm				
Db------------- Dovray	0-21	0.06-0.6	0.13-0.16	6.1-7.8	<2	High------	0.28	5	4
	21-41	<0.0-0.2	0.10-0.14	6.6-7.8	<2	High------	0.28		
	41-60	<0.06	0.10-0.18	7.4-8.4	<2	High------	0.28		
EaA, EaB--------- Egeland	0-8	2.0-6.0	0.11-0.17	5.6-7.3	<2	Low-------	0.20	5	3
	8-30	2.0-6.0	0.09-0.15	6.1-7.8	<2	Low-------	0.20		
	30-60	2.0-6.0	0.08-0.10	6.6-8.4	<2	Low-------	0.20		
Ec------------- Estelline	0-8	0.6-2.0	0.19-0.22	6.1-7.3	<2	Moderate	0.32	4	7
	8-24	0.6-2.0	0.18-0.21	6.6-7.8	<2	Moderate	0.32		
	24-60	6.0-20	0.03-0.06	7.4-8.4	<2	Low-------	0.10		
Fa------------- Flom	0-17	0.2-2.0	0.18-0.24	6.6-7.3	<2	Moderate	0.28	5	6
	17-25	0.2-0.6	0.15-0.19	6.6-8.4	<2	Moderate	0.28		
	25-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.28		
FbA------------ Fordville	0-7	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low-------	0.24	4	6
	7-24	0.6-2.0	0.18-0.21	6.1-7.8	<2	Moderate	0.24		
	24-60	6.0-20	0.03-0.06	7.4-8.4	<2	Low-------	0.10		
FcB*:									
Fordville-------	0-7	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low-------	0.24	4	6
	7-24	0.6-2.0	0.18-0.21	6.1-7.8	<2	Moderate	0.24		
	24-60	6.0-20	0.03-0.06	7.4-8.4	<2	Low-------	0.10		
Renshaw---------	0-18	2.0-6.0	0.18-0.20	6.1-7.8	<2	Low-------	0.28	3	6
	18-60	6.0-20	0.03-0.06	6.6-7.8	<2	Low-------	0.10		
FdA*, FdB*, FdC*, FdD*:									
Forman---------	0-6	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low-------	0.28	5	6
	6-23	0.6-2.0	0.15-0.19	6.6-7.8	<2	Moderate	0.28		
	23-60	0.06-0.6	0.14-0.19	7.4-8.4	<4	Moderate	0.37		
Aastad---------	0-17	0.6-2.0	0.18-0.20	6.6-7.8	<2	Moderate	0.24	5	6
	17-29	0.2-0.6	0.15-0.19	6.6-7.8	<2	Moderate	0.24		
	29-60	0.2-0.6	0.14-0.16	7.4-8.4	<2	Moderate	0.24		
FeC*:									
Forman----------	0-6	0.6-2.0	0.18-0.20	6.6-7.3	<2	Low-------	0.28	5-4	6
	6-23	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	0.28		
	23-60	0.06-0.6	0.16-0.20	7.4-8.4	2-8	Moderate	0.37		
Aastad----------	0-17	0.6-2.0	0.18-0.20	6.6-7.8	<2	Moderate	0.24	5	6
	17-29	0.2-0.6	0.15-0.19	6.6-7.8	<2	Moderate	0.32		
	29-60	0.2-0.6	0.14-0.16	7.4-8.4	<2	Moderate	0.32		
FgC*, FgE*:									
Forman----------	0-6	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low-------	0.28	5	6
	6-23	0.6-2.0	0.15-0.19	6.6-7.8	<2	Moderate	0.28		
	23-60	0.06-0.6	0.14-0.19	7.4-8.4	<4	Moderate	0.37		
Buse-----------	0-7	0.2-2.0	0.17-0.22	6.6-8.4	<2	Moderate	0.28	5	4L
	7-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
FhE*:									
Forman----------	0-6	0.6-2.0	0.18-0.20	6.6-7.3	<2	Low-------	0.28	5-4	6
	6-16	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	0.28		
	16-60	0.06-0.6	0.16-0.20	7.4-8.4	2-8	Moderate	0.37		
Buse-----------	0-7	0.6-2.0	0.18-0.20	6.6-8.4	<2	Moderate	0.28	5	6
	7-60	0.2-0.6	0.16-0.20	7.4-8.4	2-8	Moderate	0.37		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm				
HaD, HaE--------- Hattie	0-7	0.06-0.2	0.18-0.24	7.4-8.4	<2	High------	0.28	5	6
	7-60	0.06-0.2	0.12-0.16	7.4-8.4	<2	High------	0.28		
HbB*, HbC*:									
Heimdal---------	0-8	0.6-2.0	0.20-0.24	6.1-7.3	<2	Low-------	0.28	5	5
	8-22	0.6-2.0	0.17-0.19	6.6-7.8	<2	Low-------	0.28		
	22-60	0.6-6.0	0.11-0.21	7.9-8.4	<2	Low-------	0.37		
Sisseton--------	0-7	0.6-2.0	0.16-0.18	7.4-8.4	<2	Low-------	0.32	5	4L
	7-35	0.6-2.0	0.16-0.20	7.4-8.4	<2	Low-------	0.32		
	35-60	0.6-2.0	0.14-0.19	7.4-8.4	<2	Low-------	0.43		
HcA*, HcB*:									
Heimdal---------	0-8	0.6-2.0	0.20-0.24	6.1-7.3	<2	Low-------	0.28	5	5
	8-22	0.6-2.0	0.17-0.19	6.6-7.8	<2	Low-------	0.28		
	22-60	0.6-6.0	0.11-0.21	7.9-8.4	<2	Low-------	0.37		
Svea------------	0-13	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low-------	0.28	5	6
	13-28	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate	0.28		
	28-60	0.2-2.0	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
La, Lb----------- LaDelle	0-18	0.6-2.0	0.18-0.22	6.6-7.8	<2	Moderate	0.28	5	6
	18-60	0.6-2.0	0.18-0.22	7.4-8.4	<2	Moderate	0.28		
Lc--------------- Ludden	0-38	0.06-0.2	0.16-0.18	7.4-8.4	<2	High------	0.28	5	4
	38-60	0.06-0.2	0.13-0.16	7.9-8.4	<2	High------	0.28		
MaE-------------- Maddock	0-14	6.0-20	0.08-0.12	6.6-7.8	<2	Low-------	0.17	5	2
	14-60	6.0-20	0.05-0.13	6.6-8.4	<2	Low-------	0.17		
Mb--------------- Marysland	0-15	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.28	4	4L
	15-38	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.28		
	38-60	>6.0	0.02-0.07	7.4-8.4	<2	Low-------	0.15		
Oa--------------- Overly	0-12	0.2-0.6	0.17-0.23	6.6-7.8	<2	Moderate	0.32	5	7
	12-42	0.2-0.6	0.17-0.22	7.4-8.4	<2	Moderate	0.32		
	42-60	0.06-0.6	0.13-0.22	7.9-8.4	<2	Moderate	0.32		
Pa--------------- Parnell	0-11	0.06-0.2	0.14-0.17	6.1-7.8	<2	High------	0.28	5	4
	11-54	0.06-0.2	0.13-0.19	6.6-7.8	<2	High------	0.28		
	54-60	0.06-0.2	0.11-0.19	6.6-8.4	<2	High------	0.28		
Pb--------------- Parnell	0-11	0.2-0.6	0.18-0.22	6.1-7.8	<2	Moderate	0.28	5	7
	11-54	0.06-0.2	0.13-0.19	6.6-7.8	<2	High------	0.28		
	54-60	0.06-0.2	0.11-0.19	6.6-8.4	<2	High------	0.28		
PcA, PcB, PcC---- Peever	0-9	0.2-0.6	0.19-0.22	6.1-7.3	<2	Moderate	0.28	5	7
	9-42	0.06-0.6	0.11-0.19	6.6-8.4	<2	High------	0.28		
	42-60	0.06-0.6	0.08-0.17	7.4-8.4	2-8	High------	0.37		
Pd*:									
Peever----------	0-9	0.2-0.6	0.19-0.22	6.1-7.3	<2	Moderate	0.28	5	7
	9-42	0.06-0.6	0.11-0.19	6.6-8.4	<2	High------	0.28		
	42-60	0.06-0.6	0.08-0.17	7.4-8.4	2-8	High------	0.37		
Cavour----------	0-8	0.6-2.0	0.18-0.22	6.1-7.8	<2	Moderate	0.37	3	6
	8-27	<0.2	0.10-0.16	6.6-9.0	4-16	High------	0.37		
	27-60	0.06-0.6	0.11-0.15	7.4-9.0	8-16	Moderate--	0.37		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm				
Pe*:									
Peever----------	0-9	0.2-0.6	0.19-0.22	6.1-7.3	<2	Moderate	0.28	5	7
	9-42	0.06-0.6	0.11-0.19	6.6-8.4	<2	High------	0.28		
	42-60	0.06-0.6	0.08-0.17	7.4-8.4	2-8	High------	0.37		
Tonka-----------	0-23	0.6-2.0	0.18-0.23	5.6-6.5	<2	Low-------	0.32	5	6
	23-42	0.06-0.2	0.14-0.19	5.6-7.3	<2	High------	0.32		
	42-60	0.2-0.6	0.14-0.19	6.6-9.0	<2	Moderate	0.32		
Ph--------------- Playmoor	0-36	0.2-0.6	0.16-0.19	7.4-8.4	4-16	Moderate	0.28	5	4L
	36-60	0.2-0.6	0.14-0.17	7.4-8.4	4-16	Moderate	0.28		
Po--------------- Poinsett	0-8	0.6-2.0	0.19-0.22	6.1-7.3	<2	Moderate	0.32	5-4	6
	8-50	0.6-2.0	0.18-0.21	6.1-8.4	<2	Moderate	0.43		
	50-60	0.6-2.0	0.12-0.20	7.4-8.4	<2	Moderate	0.43		
Ra--------------- Rauville	0-27	0.2-2.0	0.19-0.22	7.4-8.4	<2	Moderate	0.28	5	4L
	27-45	0.2-2.0	0.17-0.20	7.4-8.4	<2	Moderate	0.28		
	45-60	2.0-6.0	0.08-0.15	7.4-8.4	<2	Low-------	0.10		
RbA, RbB--------- Renshaw	0-18	2.0-6.0	0.18-0.20	6.1-7.8	<2	Low-------	0.28	3	6
	18-60	6.0-20	0.03-0.06	6.6-7.8	<2	Low-------	0.10		
RcD*:									
Renshaw---------	0-18	2.0-6.0	0.18-0.20	6.1-7.8	<2	Low-------	0.28	3	6
	18-60	6.0-20	0.03-0.06	6.6-7.8	<2	Low-------	0.10		
Sioux-----------	0-6	2.0-6.0	0.11-0.15	6.6-8.4	<2	Low-------	0.24	2	6
	6-12	2.0-6.0	0.10-0.15	7.4-8.4	<2	Low-------	0.24		
	12-60	6.0-20	0.03-0.06	7.4-8.4	<2	Low-------	0.10		
RdE*:									
Renshaw---------	0-18	2.0-6.0	0.18-0.20	6.1-7.8	<2	Low-------	0.28	3	6
	18-60	6.0-20	0.03-0.06	6.6-7.8	<2	Low-------	0.10		
Sioux-----------	0-6	0.6-2.0	0.15-0.17	6.6-8.4	<2	Low-------	0.24	2	6
	6-12	2.0-6.0	0.08-0.12	6.6-8.4	<2	Low-------	0.24		
	12-60	6.0-20	0.03-0.06	7.4-8.4	<2	Low-------	0.10		
ReA-------------- Rentill	0-16	0.6-2.0	0.18-0.20	6.1-7.3	<2	Moderate	0.28	3	6
	16-22	6.0-20	0.03-0.06	7.4-8.4	<2	Low-------	0.10		
	22-60	0.06-0.6	0.11-0.17	7.9-9.0	<2	High------	0.37		
SaE*:									
Sioux-----------	0-6	2.0-6.0	0.11-0.15	6.6-8.4	<2	Low-------	0.24	2	6
	6-12	2.0-6.0	0.10-0.15	7.4-8.4	<2	Low-------	0.24		
	12-60	6.0-20	0.03-0.06	7.4-8.4	<2	Low-------	0.10		
Renshaw---------	0-18	2.0-6.0	0.18-0.20	6.1-7.8	<2	Low-------	0.28	3	6
	18-60	6.0-20	0.03-0.06	6.6-7.8	<2	Low-------	0.10		
SbE-------------- Sisseton	0-7	0.6-2.0	0.16-0.18	7.4-8.4	<2	Low-------	0.32	5	4L
	7-35	0.6-2.0	0.16-0.20	7.4-8.4	<2	Low-------	0.32		
	35-60	0.6-2.0	0.14-0.19	7.4-8.4	<2	Low-------	0.43		
ScD*:									
Sisseton--------	0-7	0.6-2.0	0.16-0.18	7.4-8.4	<2	Low-------	0.32	5	4L
	7-35	0.6-2.0	0.16-0.20	7.4-8.4	<2	Low-------	0.32		
	35-60	0.6-2.0	0.14-0.19	7.4-8.4	<2	Low-------	0.43		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm				
ScD*:									
Heimdal----------	0-8	0.6-2.0	0.20-0.24	6.1-7.3	<2	Low-------	0.28	5	5
	8-22	0.6-2.0	0.17-0.19	6.6-7.8	<2	Low-------	0.28		
	22-60	0.6-6.0	0.11-0.21	7.9-8.4	<2	Low-------	0.37		
Sd--------------- Svea	0-13	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low-------	0.28	5	6
	13-28	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate	0.28		
	28-60	0.2-2.0	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
SeA-------------- Swenoda	0-12	2.0-6.0	0.11-0.17	6.1-7.3	<2	Low-------	0.20	5	3
	12-26	2.0-6.0	0.11-0.17	6.6-7.8	<2	Low-------	0.20		
	26-60	0.2-2.0	0.17-0.20	7.4-8.4	<2	Moderate	0.37		
Ta--------------- Tonka	0-23	0.6-2.0	0.18-0.23	5.6-7.3	<2	Low-------	0.32	5	6
	23-42	0.06-0.2	0.14-0.19	5.6-7.3	<2	High------	0.32		
	42-60	0.2-0.6	0.14-0.19	6.6-9.0	<2	Moderate	0.32		
Va--------------- Vallers	0-15	0.6-2.0	0.22-0.24	7.4-8.4	<2	Low-------	0.28	5	4L
	15-60	0.2-0.6	0.17-0.19	7.4-8.4	<2	Low-------	0.28		
Vb*:									
Vallers----------	0-15	0.6-2.0	0.22-0.24	7.4-8.4	<2	Low-------	0.28	5	4L
	15-60	0.2-0.6	0.17-0.19	7.4-8.4	<2	Low-------	0.28		
Parnell----------	0-11	0.06-0.2	0.14-0.17	6.1-7.8	<2	High------	0.28	5	4
	11-54	0.06-0.2	0.13-0.19	6.6-7.8	<2	High------	0.28		
	54-60	0.06-0.2	0.11-0.19	6.6-8.4	<2	High------	0.28		
Vc*:									
Vallers----------	0-15	0.6-2.0	0.22-0.24	7.4-8.4	<2	Low-------	0.28	5	4L
	15-60	0.2-0.6	0.17-0.19	7.4-8.4	<2	Low-------	0.28		
Tonka------------	0-23	0.6-2.0	0.18-0.23	5.6-7.3	<2	Low-------	0.32	5	6
	23-42	0.06-0.2	0.14-0.19	5.6-7.3	<2	High------	0.32		
	42-60	0.2-0.6	0.14-0.19	6.6-9.0	<2	Moderate	0.32		
VdD*:									
Vienna-----------	0-10	0.6-2.0	0.19-0.22	6.1-7.3	<2	Moderate	0.32	5	6
	10-15	0.6-2.0	0.17-0.20	6.1-7.3	<2	Moderate	0.32		
	15-28	0.2-0.6	0.16-0.20	6.6-8.4	<2	Moderate	0.32		
	28-60	0.2-0.6	0.16-0.20	7.4-8.4	2-4	Moderate	0.32		
Buse-------------	0-7	0.2-2.0	0.17-0.22	6.6-8.4	<2	Moderate	0.28	5	4L
	7-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
VeA*, VeB*, VeC*:									
Vienna-----------	0-10	0.6-2.0	0.19-0.22	6.1-7.3	<2	Moderate	0.32	5	6
	10-15	0.6-2.0	0.17-0.20	6.1-7.3	<2	Moderate	0.32		
	15-28	0.2-0.6	0.16-0.20	6.6-8.4	<2	Moderate	0.32		
	28-60	0.2-0.6	0.16-0.20	7.4-8.4	2-4	Moderate	0.32		
Lismore----------	0-17	0.6-2.0	0.19-0.22	6.1-7.3	<2	Moderate	0.28	5	6
	17-29	0.2-0.6	0.18-0.22	6.6-7.8	<2	Moderate	0.28		
	29-60	0.2-0.6	0.16-0.18	7.4-8.4	<2	Moderate	0.37		

*See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

[The definitions of "flooding" and "water table" in the Glossary explain terms such as "rare," "brief," "apparent," and "perched." The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
Aa*:										
Aastad----------	B	Frequent----	Brief-----	Mar-Oct	3.0-6.0	Perched	Oct-Jun	High-----	High-----	Moderate.
Flom------------	B/D	Frequent----	Brief-----	Mar-Oct	1.0-3.0	Apparent	Nov-Jun	High-----	High-----	Low.
AbA, AbB, AbC----- Arvilla	A	None--------	---	---	>6.0	---	---	Low------	Moderate	Low.
BaE*:										
Barnes----------	B	None--------	---	---	>6.0	---	---	Moderate	High-----	Low.
Buse------------	B	None--------	---	---	>6.0	---	---	Moderate	High-----	Moderate.
BbB*, BbC*, BbD*:										
Barnes----------	B	None--------	---	---	>6.0	---	---	Moderate	High-----	Low.
Svea------------	B	Frequent----	Very brief	Apr-Jul	4.0-6.0	Apparent	Apr-Jun	Moderate	High-----	Low.
Bc--------------- Bearden	C	None--------	---	---	1.5-2.5	Apparent	Sep-Jun	High-----	High-----	Low.
Bd--------------- Brookings	B	Common------	Very brief	Mar-Oct	3.0-6.0	Perched	Mar-Jul	High-----	High-----	Moderate.
BeF*:										
Buse------------	B	None--------	---	---	>6.0	---	---	Moderate	Low------	Low.
Forman----------	B	None--------	---	---	>6.0	---	---	Moderate	High-----	Low.
BfD*:										
Buse------------	B	None--------	---	---	>6.0	---	---	Moderate	Low------	Low.
Forman----------	B	None--------	---	---	>6.0	---	---	Moderate	High-----	Low.
Aastad----------	B	Frequent----	Brief-----	Mar-Oct	3.0-6.0	Perched	Oct-Jun	High-----	High-----	Moderate.
Da--------------- Divide	B	None--------	---	---	2.5-5.0	Apparent	Sep-Jun	Moderate	High-----	Low.
Db--------------- Dovray	C/D	Common------	Brief-----	Apr-Nov	0.-3.0	Apparent	Jan-Dec	Moderate	High-----	Low.
EaA, EaB--------- Egeland	B	None--------	---	---	>6.0	---	---	Low------	Moderate	Low.
Ec--------------- Estelline	B	None--------	---	---	>6.0	---	---	Low------	Moderate	Low.
Fa--------------- Flom	B/D	Frequent----	Brief-----	Mar-Oct	1.0-3.0	Apparent	Nov-Jun	High-----	High-----	Low.
FbA-------------- Fordville	B	None--------	---	---	>6.0	---	---	Low------	Moderate	Low.
FcB*:										
Fordville--------	B	None--------	---	---	>6.0	---	---	Low------	Moderate	Low.
Renshaw----------	B	None--------	---	---	>6.0	---	---	Low------	Moderate	Low.
FdA*, FdB*, FdC*, FdD*:										
Forman----------	B	None--------	---	---	>6.0	---	---	Moderate	High-----	Low.
Aastad----------	B	Frequent----	Brief-----	Mar-Oct	3.0-6.0	Perched	Oct-Jun	High-----	High-----	Moderate.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft					
FeC*:										
Forman	B	None	---	---	>6.0	---	---	Moderate	High	Moderate.
Aastad	B	Frequent	Brief	Mar-Oct	3.0-6.0	Perched	Oct-Jun	High	High	Moderate.
FgC*, FgE*:										
Forman	B	None	---	---	>6.0	---	---	Moderate	High	Low.
Buse	B	None	---	---	>6.0	---	---	Moderate	Low	Low.
FhE*:										
Forman	B	None	---	---	>6.0	---	---	Moderate	High	Moderate.
Buse	B	None	---	---	>6.0	---	---	Moderate	High	Moderate.
HaD, HaE Hattie	C	None	---	---	>6.0	---	---	Moderate	High	Low.
HbB*, HbC*:										
Heimdal	B	None	---	---	>6.0	---	---	Moderate	High	Low.
Sisseton	B	None	---	---	>6.0	---	---	Moderate	High	Low.
HcA*, HcB*:										
Heimdal	B	None	---	---	>6.0	---	---	Moderate	High	Low.
Svea	B	Frequent	Very brief	Apr-Jul	4.0-6.0	Apparent	Apr-Jun	Moderate	High	Low.
La, Lb LaDelle	B	Frequent	Brief	Apr-Jun	4.0-6.0	Apparent	Oct-Jun	High	High	Low.
Lc Ludden	D	Frequent	Brief to long.	Mar-Jun	0-2.0	Apparent	Mar-Jun	High	High	Low.
MaE Maddock	A	None	---	---	>6.0	---	---	Low	Moderate	Low.
Mb Marysland	B/D	Rare	---	---	0-1.0	Apparent	Nov-Jul	High	High	Low.
Oa Overly	C	None	---	---	>6.0	---	---	High	High	Low.
Pa Parnell	C/D	Frequent	Long	Apr-Nov	0-2.0	Apparent	Jan-Dec	High	High	Low.
Pb** Parnell	C/D	Frequent	Very long	Jan-Dec	+2-1.0	Apparent	Jan-Dec	High	High	Low.
PcA, PcB, PcC Peever	C	None	---	---	>6.0	---	---	Moderate	High	Moderate.
Pd*:										
Peever	C	None	---	---	>6.0	---	---	Moderate	High	Moderate.
Cavour	D	None	---	---	>6.0	---	---	Moderate	High	Moderate.
Pe*:										
Peever	C	None	---	---	>6.0	---	---	Moderate	High	Moderate.
Tonka	C/D	Common	Long	Apr-Jun	0-1.0	Apparent	Sep-Jun	High	High	Low.
Ph Playmoor	C/D	Frequent	Brief	Mar-Jun	0.5-3.5	Apparent	Sep-Jun	High	High	High.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
Po----------------- Poinsett	B	None--------	---	---	>6.0	---	---	High-----	High-----	Low.
Ra----------------- Rauville	D	Frequent----	Brief-----	Mar-Oct	0-2.0	Apparent	Jan-Dec	High-----	High-----	Moderate.
RbA, RbB---------- Renshaw	B	None--------	---	---	>6.0	---	---	Low------	Moderate	Low.
RcD*:										
Renshaw----------	B	None--------	---	---	>6.0	---	---	Low------	Moderate	Low.
Sioux------------	A	None--------	---	---	>6.0	---	---	Low------	Low------	Low.
RdE*:										
Renshaw----------	B	None--------	---	---	>6.0	---	---	Low------	Moderate	Low.
Sioux------------	A	None--------	---	---	>6.0	---	---	Low------	Low------	Low.
ReA--------------- Rentill	B	None--------	---	---	>6.0	---	---	Moderate	High-----	Moderate.
SaE*:										
Sioux------------	A	None--------	---	---	>6.0	---	---	Low------	Low------	Low.
Renshaw----------	B	None--------	---	---	>6.0	---	---	Low------	Moderate	Low.
SbE--------------- Sisseton	B	None--------	---	---	>6.0	---	---	Moderate	High-----	Low.
ScD*:										
Sisseton---------	B	None--------	---	---	>6.0	---	---	Moderate	High-----	Low.
Heimdal----------	B	None--------	---	---	>6.0	---	---	Moderate	High-----	Low.
Sd---------------- Svea	B	Frequent----	Very brief	Apr-Jul	4.0-6.0	Apparent	Apr-Jun	Moderate	High-----	Low.
SeA--------------- Swenoda	B	None--------	---	---	2.5-4.0	Perched	Mar-Jun	Moderate	High-----	Moderate.
Ta---------------- Tonka	C/D	Common------	Long------	Apr-Jun	0-1.0	Apparent	Sep-Jun	High-----	High-----	Low.
Va---------------- Vallers	C	Rare--------	---	---	1.0-2.5	Apparent	Nov-Jun	High-----	High-----	Low.
Vb*:										
Vallers----------	C	Rare--------	---	---	1.0-2.5	Apparent	Nov-Jun	High-----	High-----	Low.
Parnell----------	C/D	Frequent----	Long------	Apr-Nov	0-2.0	Apparent	Jan-Dec	High-----	High-----	Low.
Vc*:										
Vallers----------	C	Rare--------	---	---	1.0-2.5	Apparent	Nov-Jun	High-----	High-----	Low.
Tonka------------	C/D	Common------	Long------	Apr-Jun	0-1.0	Apparent	Sep-Jun	High-----	High-----	Low.
VdD*:										
Vienna-----------	B	None--------	---	---	>6.0	---	---	Moderate	High-----	Moderate.
Buse-------------	B	None--------	---	---	>6.0	---	---	Moderate	Low------	Low.
VeA*, VeB*, VeC*:										
Vienna-----------	B	None--------	---	---	>6.0	---	---	Moderate	High-----	Moderate.
Lismore----------	B	Common------	Very brief	Apr-Jun	3.0-6.0	Perched	Oct-Jun	High-----	High-----	Moderate.

* See description of the map unit for composition and behavior characteristics of the map unit.

** In the "High water table--Depth" column, a plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

TABLE 17.--ENGINEERING TEST DATA

[Dashes indicate that data were not available. NP means nonplastic]

Soil name, report number, horizon, and depth in inches	Classification		Grain size distribution								Liquid limit	Plasticity index	Moisture density	
			Percentage passing sieve					Percentage smaller than--						
	AASHTO	Unified	3/8 inch	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm			Max. dry density	Optimum moisture
											Pct		Lb/ft	Pct
Aastad loam: (S73SD-025-020)														
A12----- 6 to 11	A-7-5(09)	ML	100	100	99	92	74	--	37	--	41	11	96	24
B2------ 17 to 29	A-6 (06)	CL	100	97	93	82	60	--	29	--	37	13	110	17
C1ca---- 29 to 38	A-6 (05)	CL	100	93	90	80	58	--	30	--	35	13	112	16
Divide loam: (S74SD-051-007)														
A1ca---- 7 to 19	A-4 (03)	ML	100	99	98	81	52	--	24	--	37	9	102	20
C1ca---- 19 to 23	A-4 (03)	CL	100	100	98	84	52	--	22	--	33	10	111	16
IIC3---- 30 to 60	A-2-4(00)	SM	100	80	66	40	34	--	3	--	18	NP	116	11
Egeland sandy loam: (S65SD-025-035)														
B21----- 9 to 15	A-2-4(00)	SM-SC	100	100	100	86	35	--	15	--	24	7	119	13
B22----- 15 to 27	A-2-4(00)	SM	100	100	100	87	20	--	9	--	17	NP	122	12
C1ca---- 35 to 48	A-2-4(00)	SM	100	100	100	85	19	--	9	--	18	NP	120	12
LaDelle silt loam: (S73SD-025-008)														
A12----- 6 to 18	A-7-5(14)	ML	100	100	100	99	86	--	36	--	46	13	88	30
C1------ 18 to 36	A-7-5(18)	ML	100	100	100	100	91	--	46	--	49	15	89	28
C2------ 36 to 60	A-7-5(23)	MH	100	100	100	100	91	--	48	--	51	21	92	26
Ludden silty clay: (S74SD-051-006)														
A12----- 7 to 18	A-7-5(39)	MH	100	100	100	99	92	--	55	--	70	35	86	30
C1gcacs- 18 to 27	A-7-5(40)	MH	100	100	100	97	89	--	59	--	73	38	89	28
C2gcs--- 27 to 56	A-7-5(31)	MH	100	100	100	94	86	--	55	--	66	30	95	24
Parnell silty clay loam: (S73SD-025-010)														
A11----- 0 to 11	A-7-5(25)	MH	100	100	100	98	91	--	46	--	63	20	81	32
B22tg--- 16 to 40	A-7-5(31)	MH	100	100	100	99	98	--	60	--	59	25	89	28
B22tg--- 40 to 54	A-7-5(42)	MH	100	100	100	100	98	--	66	--	71	34	89	28

TABLE 17.--ENGINEERING TEST DATA--Continued

Soil name, report number, horizon, and depth in inches	Classification		Grain size distribution								Liquid limit	Plasticity index	Moisture density	
			Percentage passing sieve					Percentage smaller than--						
	AASHTO	Unified	3/8 inch	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm			Max. dry density	Optimum moisture
											Pct		Lb/ft	Pct
Rauville silty clay loam: (S65SD-025-014)														
A12g---- 7 to 27	A-7-5(21)	MH	100	100	100	98	93	--	55	--	60	15	79	35
C1g----- 27 to 45	A-7-6(1)	CL	100	100	100	98	95	--	37	--	43	17	99	22
IIC2---- 45 to 60	A-2-4(00)	SC	100	84	77	52	33	--	10	--	27	10	125	11
Renshaw loam: (S73SD-025-009)														
B21----- 6 to 11	A-5 (05)	ML	100	100	99	84	61	--	24	--	42	10	97	23
B22----- 11 to 18	A-4 (03)	ML	100	97	96	81	57	--	21	--	33	9	105	19
IIC2---- 23 to 60	A-1-B(01)	SW-SM	100	76	61	28	8	--	3	--	21	NP	123	12
Tonka silt loam: (S73SD-025-001)														
A2------ 10 to 23	A-4 (02)	CL-ML	100	100	100	97	82	--	26	--	25	4	104	20
B21t---- 23 to 31	A-7-6(21)	CL	100	100	100	98	91	--	46	--	46	21	102	20
B22t---- 31 to 42	A-7-6(16)	CL	100	100	99	97	84	--	37	--	42	18	107	18
C1------ 50 to 60	A-6 (06)	CL	100	100	98	88	54	--	21	--	30	19	115	15

TABLE 18.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Aastad	Fine-loamy, mixed Pachic Udic Haploborolls
Arvilla	Sandy, mixed Udic Haploborolls
Barnes	Fine-loamy, mixed Udic Haploborolls
Bearden	Fine-silty, frigid Aeric Calciaquolls
Brookings	Fine-silty, mixed Pachic Udic Haploborolls
Buse	Fine-loamy, mixed Udorthentic Haploborolls
Cavour	Fine, montmorillonitic Udic Natriborolls
Divide	Fine-loamy over sandy or sandy-skeletal, frigid Aeric Calciaquolls
Dovray	Fine, montmorillonitic, frigid Cumulic Haplaquolls
Egeland	Coarse-loamy, mixed Udic Haploborolls
Estelline	Fine-silty over sandy or sandy-skeletal, mixed Pachic Udic Haploborolls
Flom	Fine-loamy, mixed, frigid Typic Haplaquolls
Fordville	Fine-loamy over sandy or sandy-skeletal, mixed Pachic Udic Haploborolls
Forman	Fine-loamy, mixed Udic Argiborolls
Hattie	Fine, montmorillonitic Udertic Haploborolls
Heimdal	Coarse-loamy, mixed Udic Haploborolls
LaDelle	Fine-silty, mixed Cumulic Udic Haploborolls
Lismore	Fine-loamy, mixed Pachic Udic Haploborolls
Ludden	Fine, montmorillonitic (calcareous), frigid Vertic Haplaquolls
Maddock	Sandy, mixed Udorthentic Haploborolls
Marysland	Fine-loamy over sandy or sandy-skeletal, frigid Typic Calciaquolls
Overly	Fine-silty, mixed Pachic Udic Haploborolls
Parnell	Fine, montmorillonitic, frigid Typic Argiaquolls
Peever	Fine, montmorillonitic Udic Argiborolls
Playmoor	Fine-silty, mixed (calcareous), frigid Cumulic Haplaquolls
Poinsett	Fine-silty, mixed Udic Haploborolls
Rauville	Fine-silty, mixed (calcareous), frigid Cumulic Haplaquolls
Renshaw	Fine-loamy over sandy or sandy-skeletal, mixed Udic Haploborolls
Rentill	Coarse-loamy over clayey, mixed Udic Haploborolls
Sioux	Sandy-skeletal, mixed Udorthentic Haploborolls
Sisseton	Coarse-loamy, mixed (calcareous), frigid Typic Udorthents
Svea	Fine-loamy, mixed Pachic Udic Haploborolls
Swenoda	Coarse-loamy, mixed Pachic Udic Haploborolls
Tonka	Fine, montmorillonitic, frigid Argiaquic Argialbolls
Vallers	Fine-loamy, frigid Typic Calciaquolls
Vienna	Fine-loamy, mixed Udic Haploborolls

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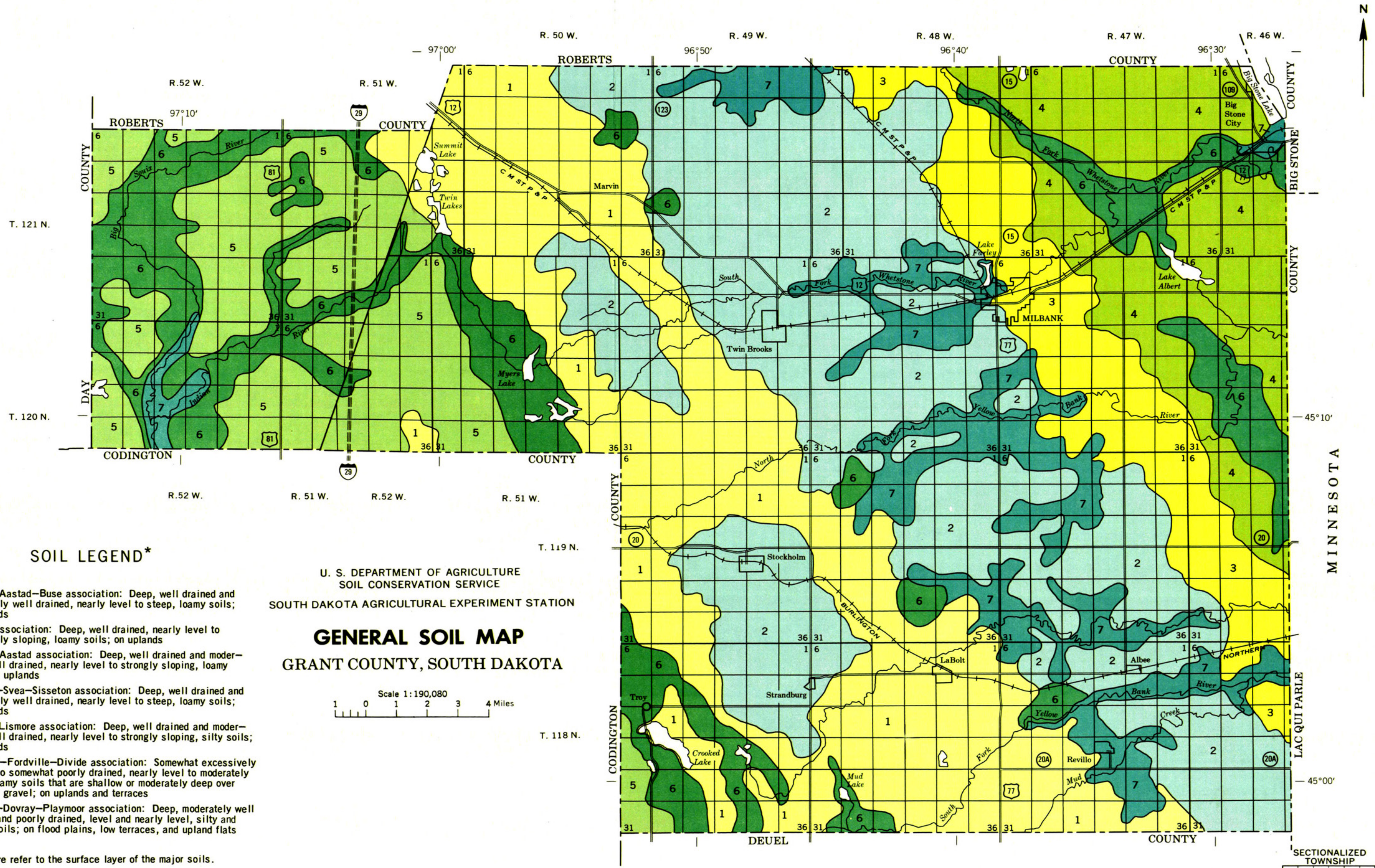


SOIL LEGEND*

1	Forman–Aastad–Buse association: Deep, well drained and moderately well drained, nearly level to steep, loamy soils; on uplands
2	Peever association: Deep, well drained, nearly level to moderately sloping, loamy soils; on uplands
3	Forman–Aastad association: Deep, well drained and moderately well drained, nearly level to strongly sloping, loamy soils; on uplands
4	Heimdal–Svea–Sisseton association: Deep, well drained and moderately well drained, nearly level to steep, loamy soils; on uplands
5	Vienna–Lismore association: Deep, well drained and moderately well drained, nearly level to strongly sloping, silty soils; on uplands
6	Renshaw–Fordville–Divide association: Somewhat excessively drained to somewhat poorly drained, nearly level to moderately steep, loamy soils that are shallow or moderately deep over sand and gravel; on uplands and terraces
7	LaDelle–Dovray–Playmoor association: Deep, moderately well drained and poorly drained, level and nearly level, silty and clayey soils; on flood plains, low terraces, and upland flats

* Terms for texture refer to the surface layer of the major soils.

Compiled 1978

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

GRANT COUNTY, SOUTH DAKOTA

Scale 1:190,080

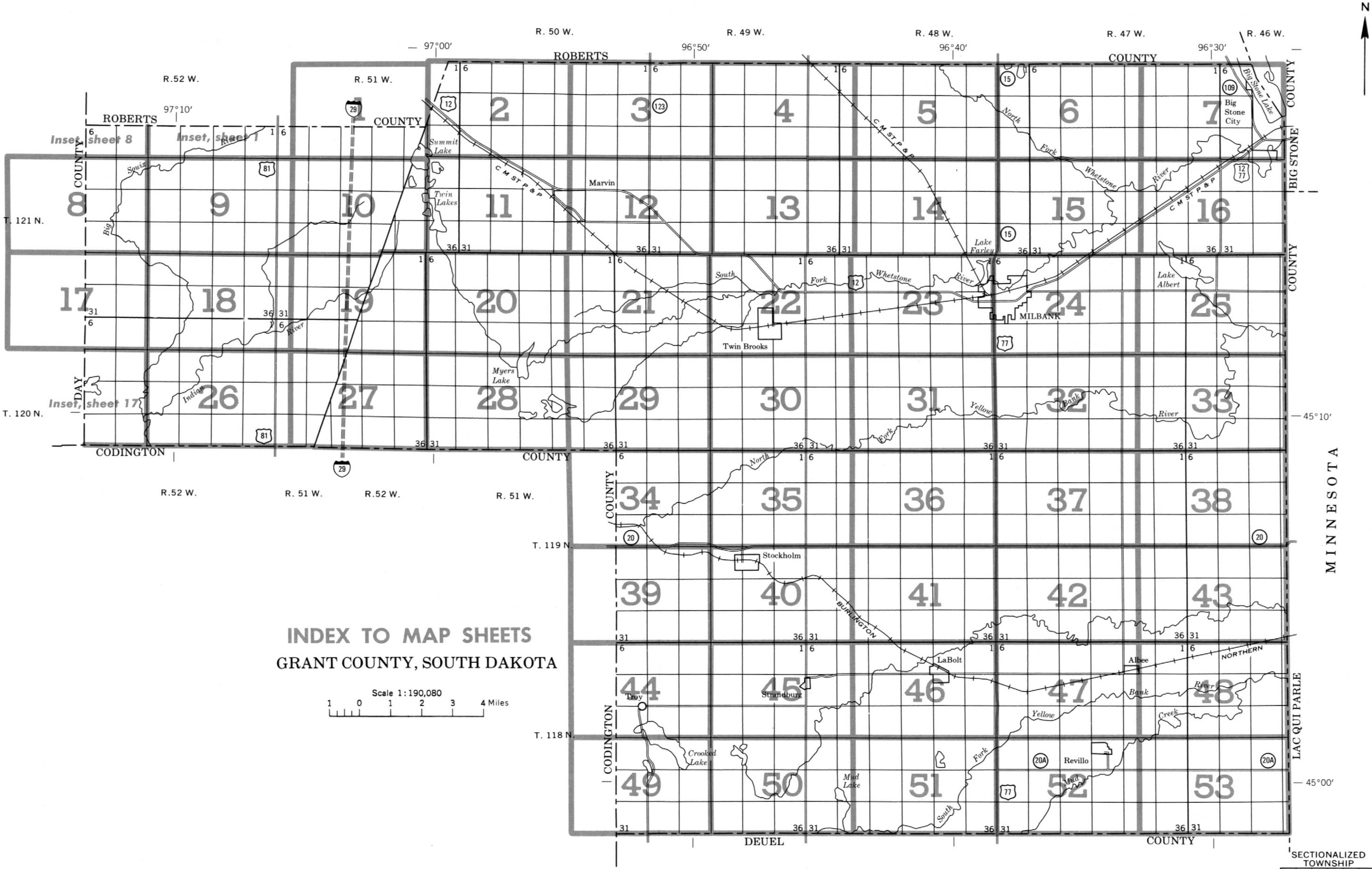
1 0 1 2 3 4 Miles

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

INDEX TO MAP SHEETS

GRANT COUNTY, SOUTH DAKOTA



6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL LEGEND

Each symbol consists of two or three letters; for example Ao, BaA, or BaB. If slope is given in the soil name, the third letter A, B, C, D, E, or F indicates the class of slope. The slope is given in the map unit description when not a part of the soil name.

SYMBOL	NAME
Aa	Aastad–Flom complex
AbA	Arvilla sandy loam, 0 to 2 percent slopes
AbB	Arvilla sandy loam, 2 to 6 percent slopes
AbC	Arvilla sandy loam, 6 to 9 percent slopes
BaE	Barnes–Buse extremely stony loams, 9 to 40 percent slopes
BbB	Barnes–Svea loams, 1 to 6 percent slopes
BbC	Barnes–Svea loams, 3 to 9 percent slopes
BbD	Barnes–Svea loams, 4 to 15 percent slopes
Bc	Bearden silty clay loam
Bd	Brookings silt loam
BeF	Buse–Forman loams, 20 to 40 percent slopes
BfD	Buse–Forman–Aastad loams, 4 to 15 percent slopes
Da	Divide loam
Db	Dovray silty clay
EaA	Egeland sandy loam, 0 to 2 percent slopes
EaB	Egeland sandy loam, 2 to 6 percent slopes
Ec	Estelline silty clay loam
Fa	Flom clay loam
FbA	Fordville loam, 0 to 2 percent slopes
FcB	Fordville–Renshaw loams, 2 to 6 percent slopes
FdA	Forman–Aastad loams, 0 to 2 percent slopes
FdB	Forman–Aastad loams, 1 to 6 percent slopes
FdC	Forman–Aastad loams, 3 to 9 percent slopes
FdD	Forman–Aastad loams, 4 to 15 percent slopes
FeC	Forman–Aastad extremely stony complex, 0 to 9 percent slopes
FgC	Forman–Buse loams, 6 to 9 percent slopes
FgE	Forman–Buse loams, 15 to 25 percent slopes
FhE	Forman–Buse extremely stony loams, 9 to 40 percent slopes
HaD	Hattie clay loam, 9 to 15 percent slopes
HaE	Hattie clay loam, 15 to 40 percent slopes
HbB	Heimdal–Sisseton loams, 2 to 6 percent slopes
HbC	Heimdal–Sisseton loams, 6 to 9 percent slopes
HcA	Heimdal–Svea loams, 0 to 2 percent slopes
HcB	Heimdal–Svea loams, 2 to 6 percent slopes
La	LaDelle silt loam
Lb	LaDelle silt loam, channeled
Lc	Ludden silty clay
MaE	Maddock loamy fine sand, 6 to 25 percent slopes
Mb	Marysland loam
Oa	Overly silty clay loam
Pa	Parnell silty clay loam
Pb	Parnell silty clay loam, ponded
PcA	Peever clay loam, 0 to 2 percent slopes
PcB	Peever clay loam, 2 to 6 percent slopes
PcC	Peever clay loam, 6 to 9 percent slopes
Pd	Peever–Cavour complex
Pe	Peever–Tonka complex
Pf	Pits, gravel
Ph	Playmoor silty clay loam
Po	Poinsett silt loam
Ra	Rauville silty clay loam
RbA	Renshaw loam, 0 to 2 percent slopes
RbB	Renshaw loam, 2 to 6 percent slopes
RcD	Renshaw–Sioux complex, 6 to 15 percent slopes
RdE	Renshaw–Sioux extremely stony complex, 6 to 40 percent slopes
ReA	Rentill loam, 0 to 2 percent slopes
SaE	Sioux–Renshaw complex, 15 to 40 percent slopes
SbE	Sisseton loam, 15 to 40 percent slopes
ScD	Sisseton–Heimdal loams, 9 to 15 percent slopes
Sd	Svea loam
SeA	Swenoda fine sandy loam, 0 to 2 percent slopes
Ta	Tonka silt loam
Va	Vallers loam
Vb	Vallers–Parnell complex
Vc	Vallers–Tonka complex
VdD	Vienna–Buse complex, 9 to 15 percent slopes
VeA	Vienna–Lismore silt loams, 0 to 2 percent slopes
VeB	Vienna–Lismore silt loams, 1 to 6 percent slopes
VeC	Vienna–Lismore silt loams, 3 to 9 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool (Davis Airstrip; FLOOD POOL LINE)

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate (79)
- Federal (410)
- State (52)
- County, farm or ranch (378)

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small (water; w)

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) (Indian Mound)
- Located object (label) (Tower)
- Tank (label) (GAS)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
- Double-line (label) (CANAL)
- Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial (water; w)
- Intermittent (int; i)

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS (CeA; FoB2)

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

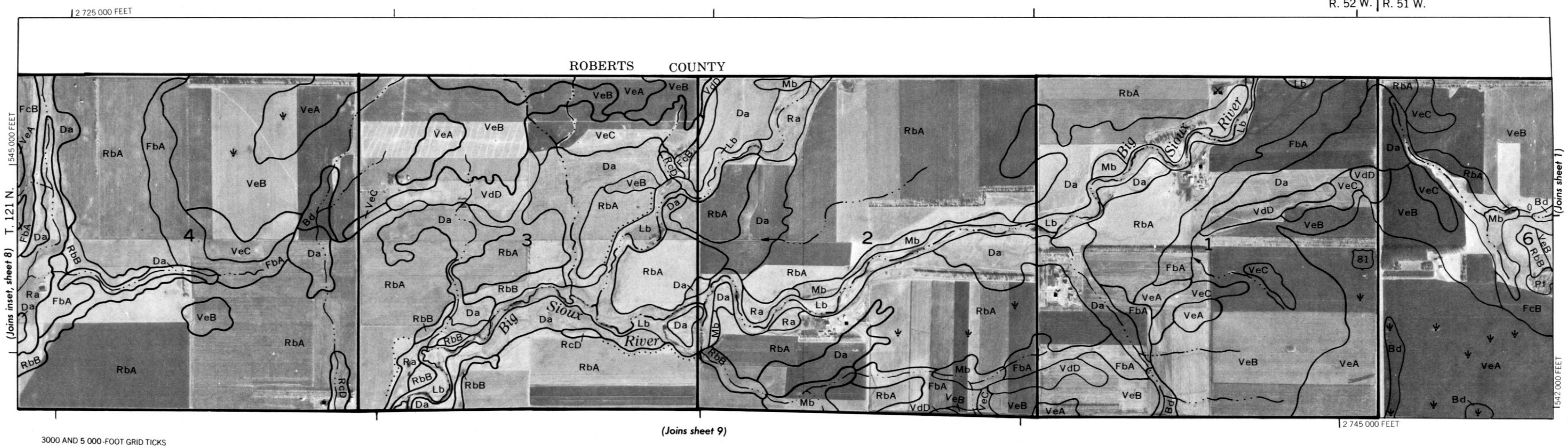
SOIL SAMPLE SITE (normally not shown)

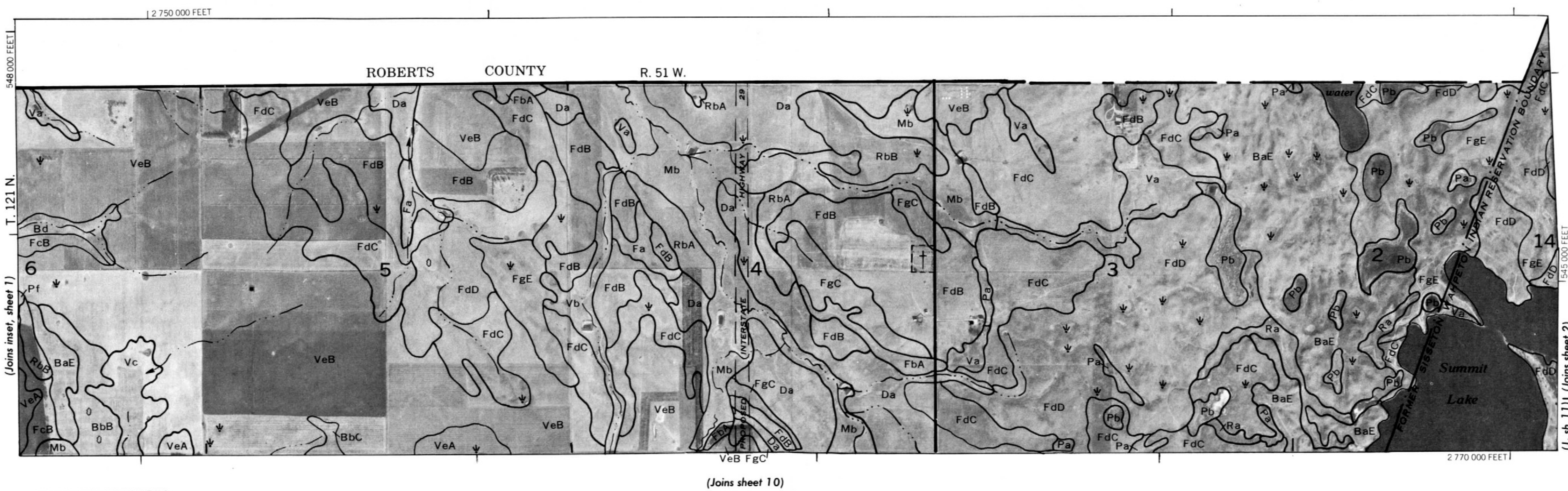
MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot

1

N





1 Mile | 5 000 Feet

Scale 1:20000

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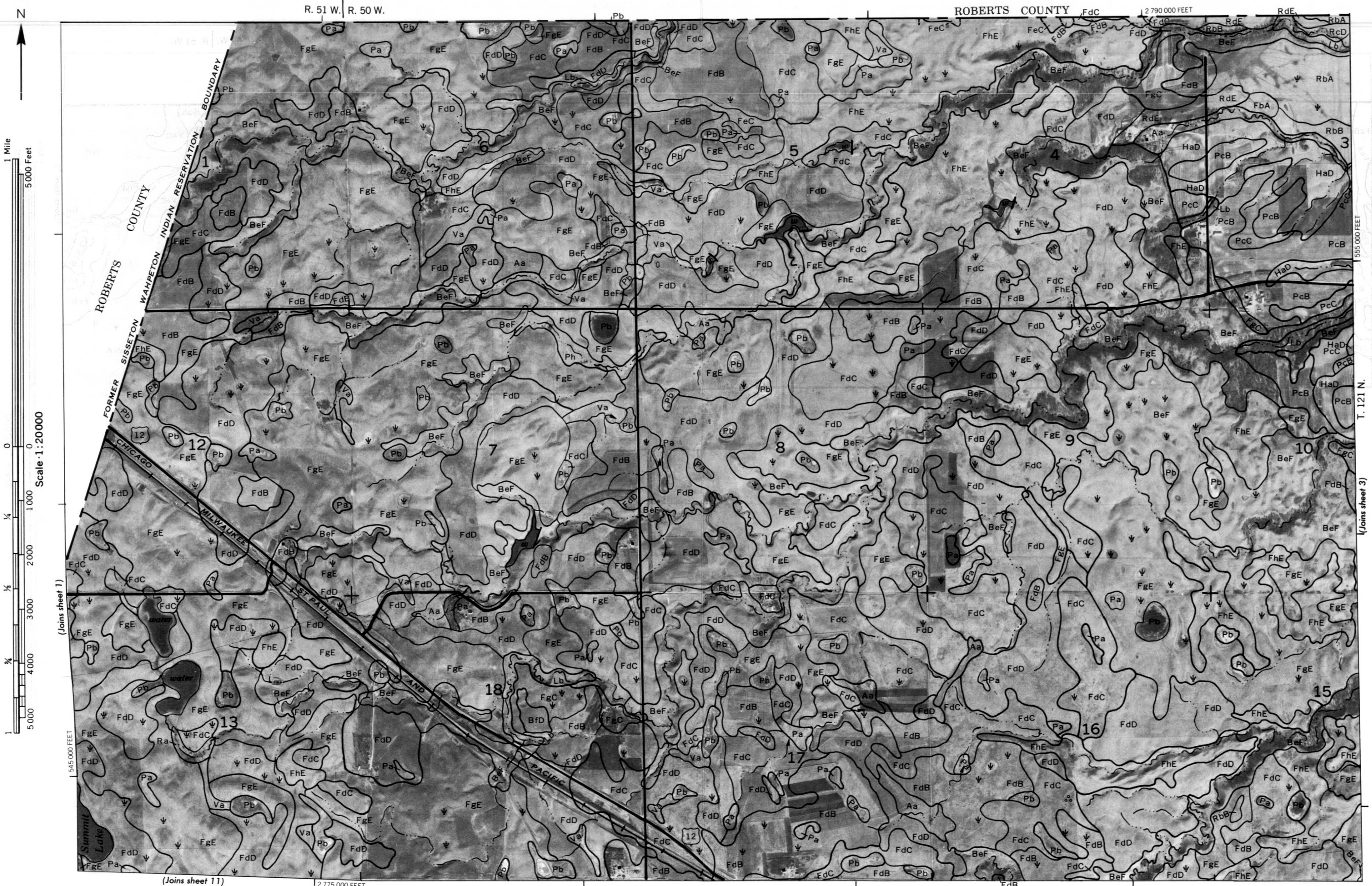
2



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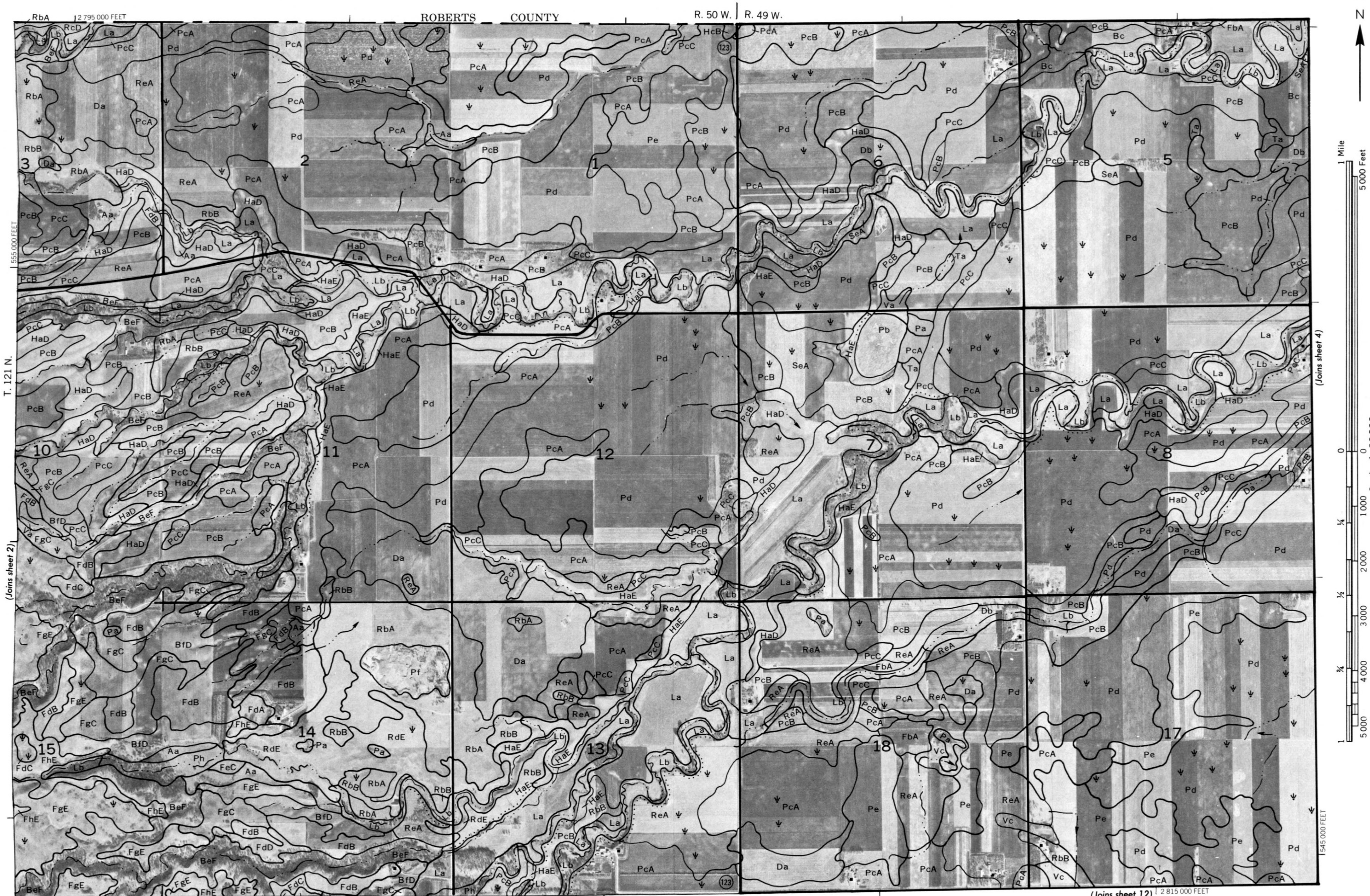

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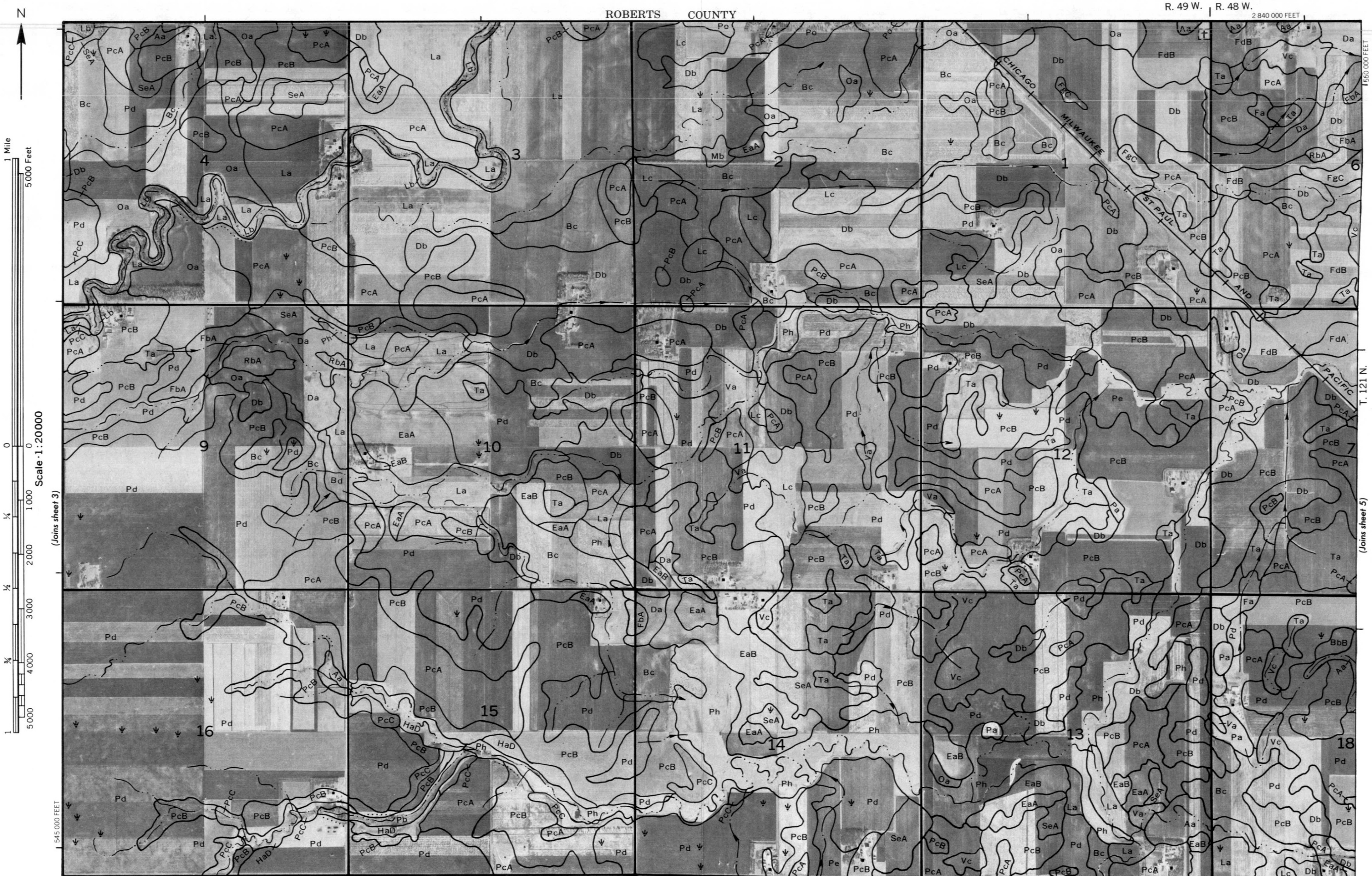
GRANT COUNTY, SOUTH DAKOTA — SHEET NUMBER 4



(Joins sheet 3)

(Joins sheet 5)

(Joins sheet 13)

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GRANT COUNTY, SOUTH DAKOTA — SHEET NUMBER 5

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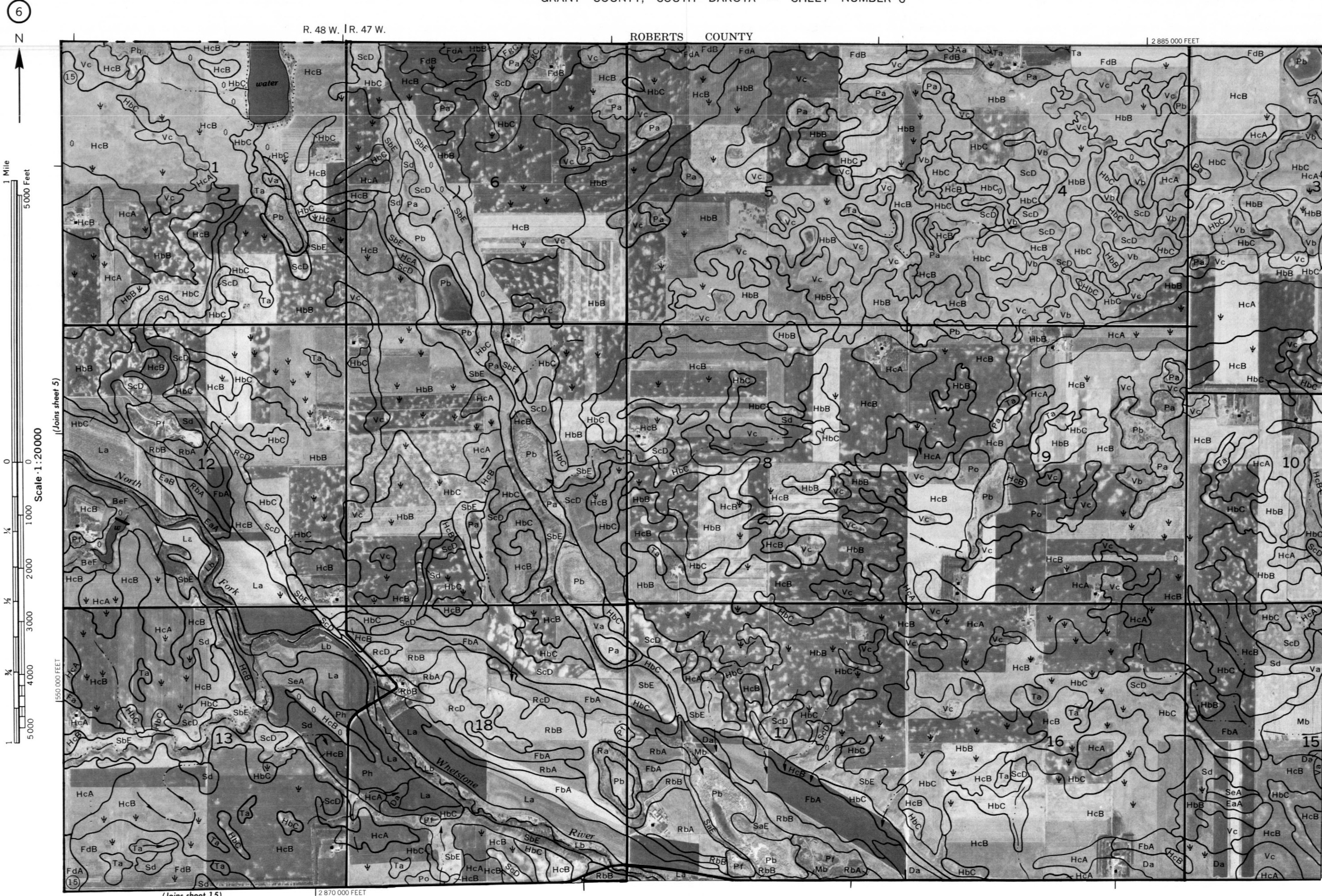

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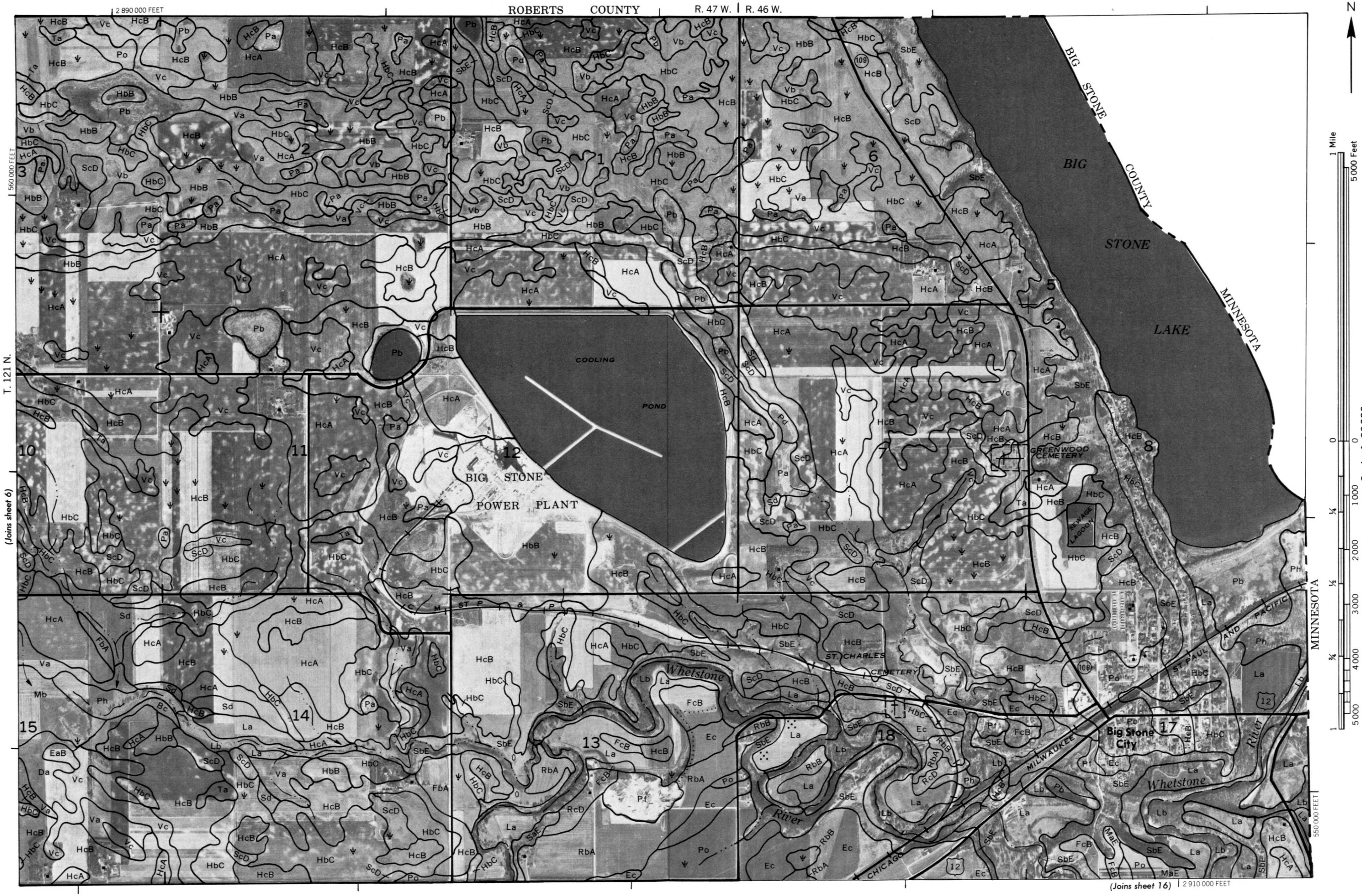
GRANT COUNTY, SOUTH DAKOTA — SHEET NUMBER 7

7



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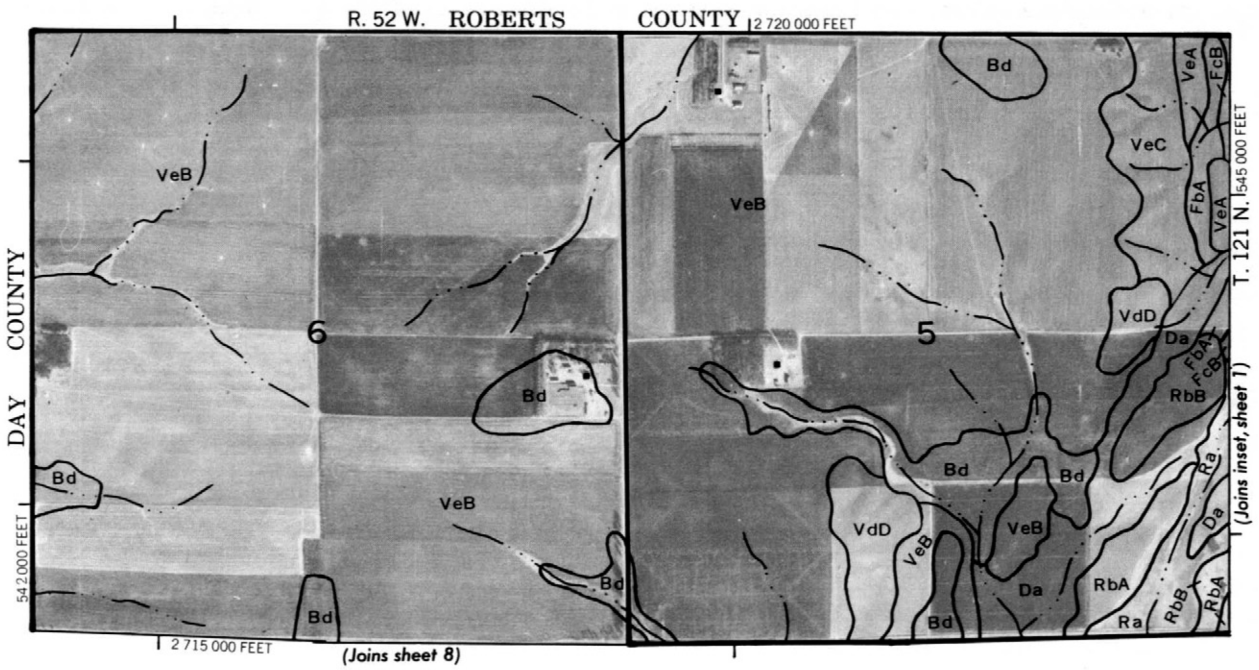
8

N

Scale 1:20000

1 Mile: 0, ¼, ½, ¾, 1

5000 Feet: 0, 1000, 2000, 3000, 4000, 5000



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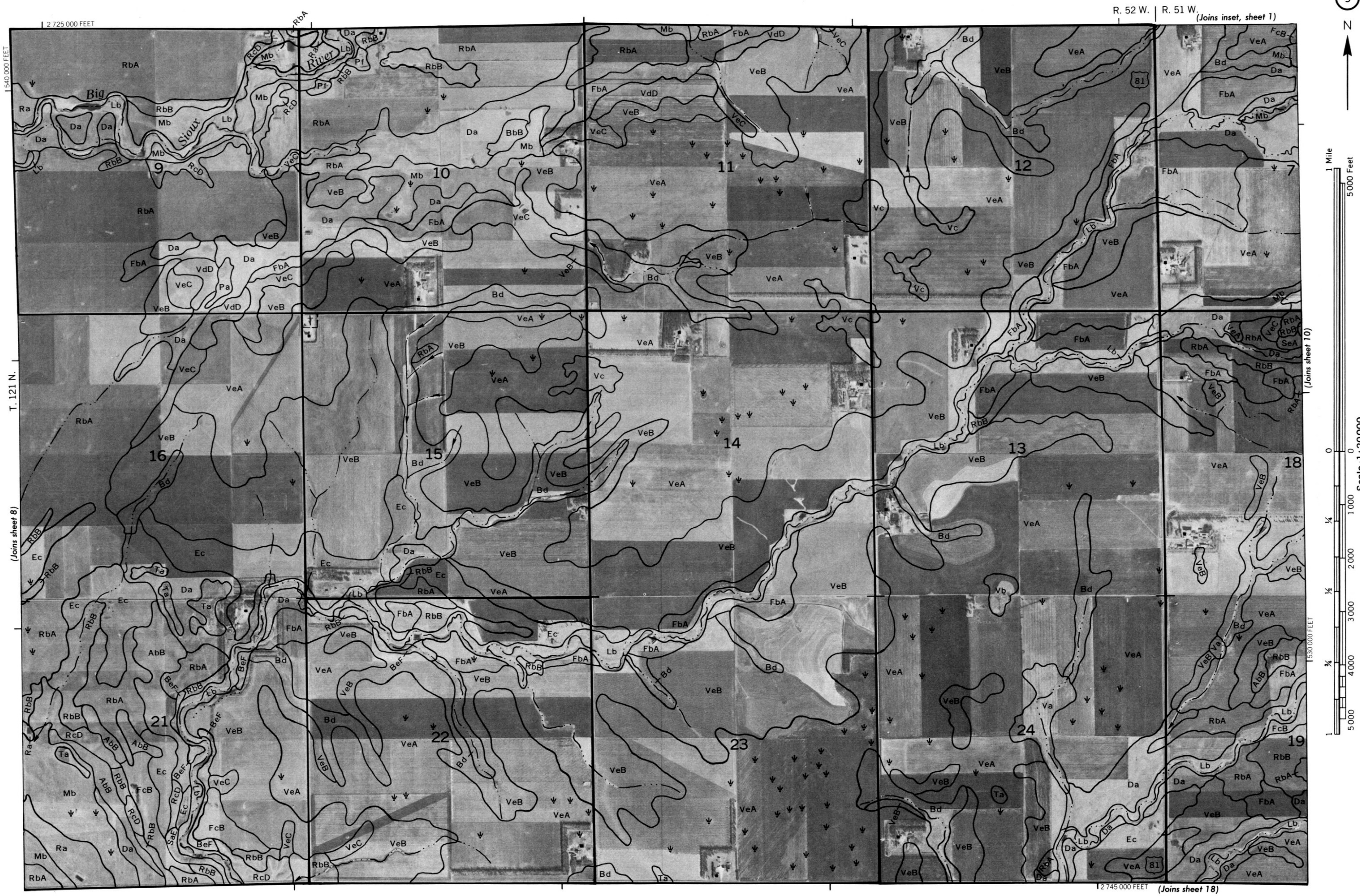

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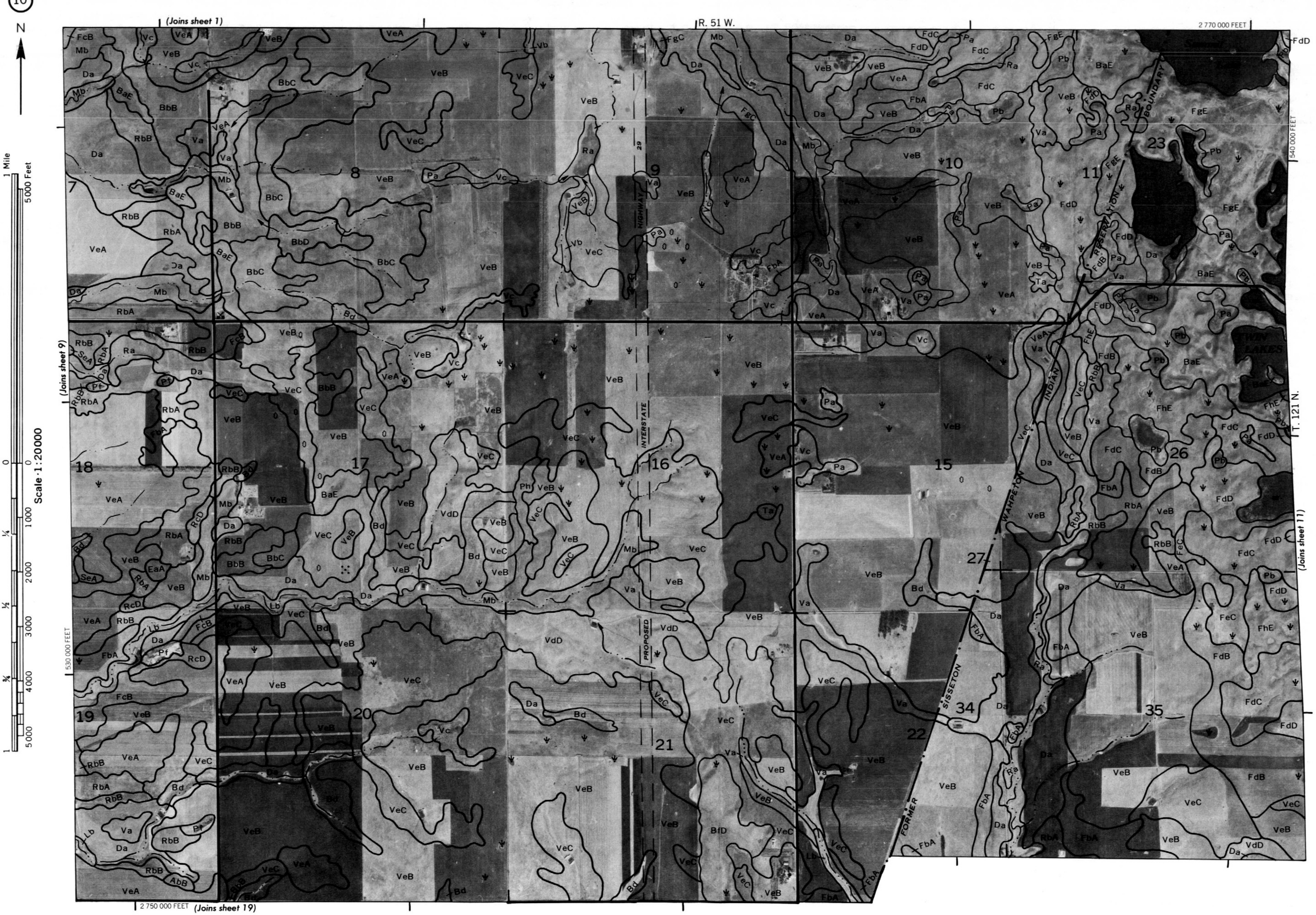

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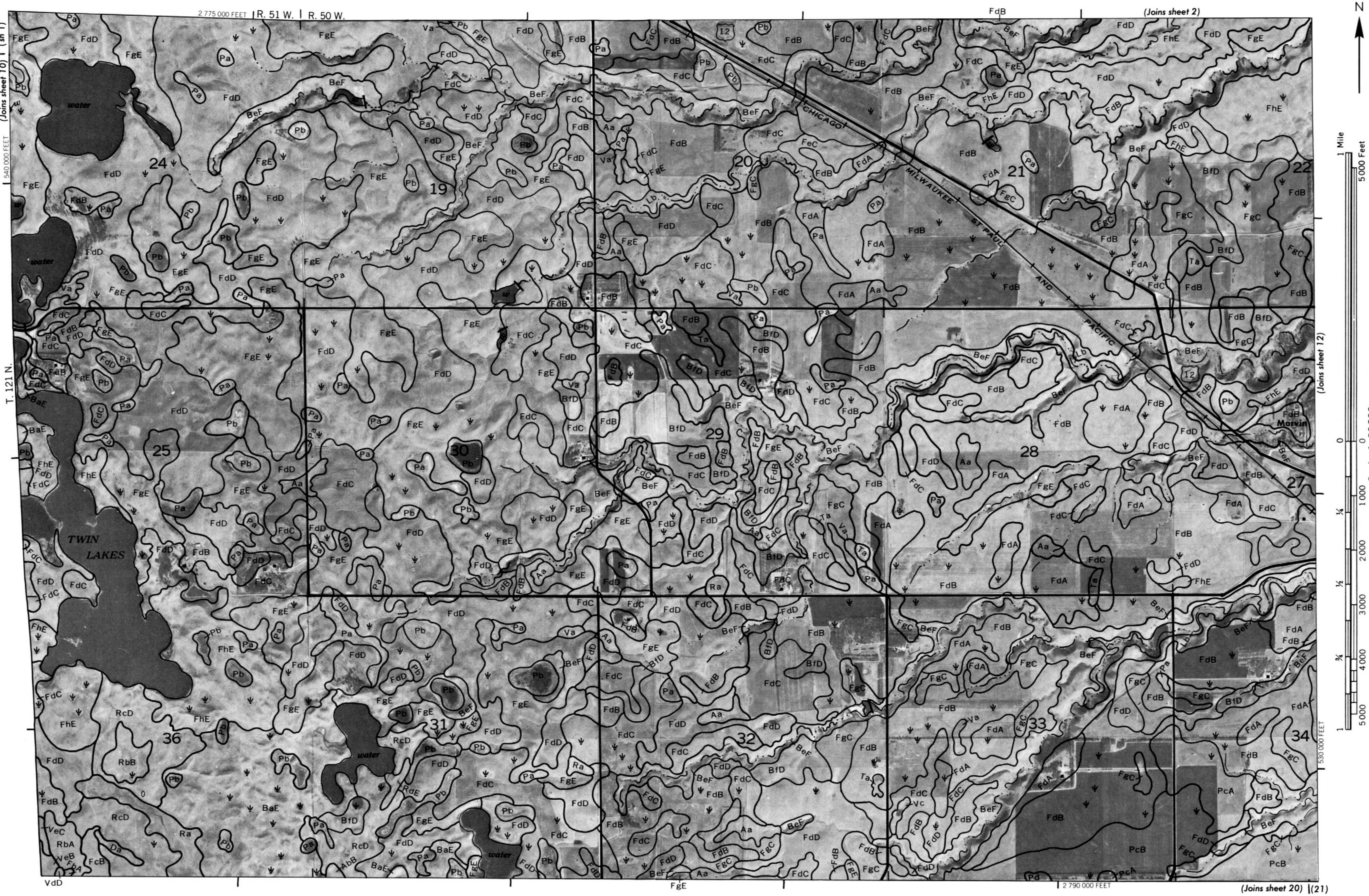

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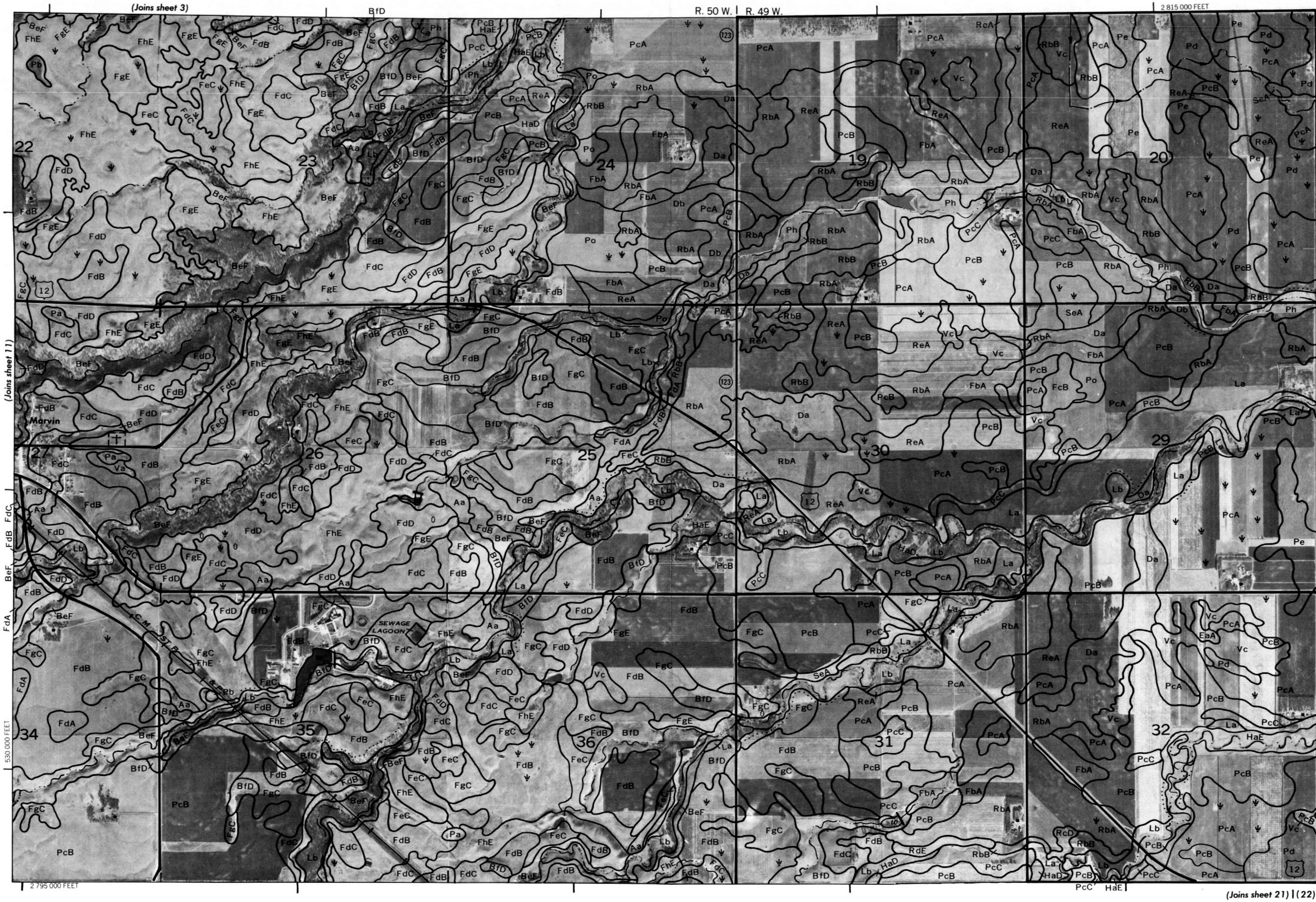
(12)

N



1 Mile
5000 Feet
Scale 1:20000
0 1000 2000 3000 4000 5000
0 ¼ ½ ¾ 1

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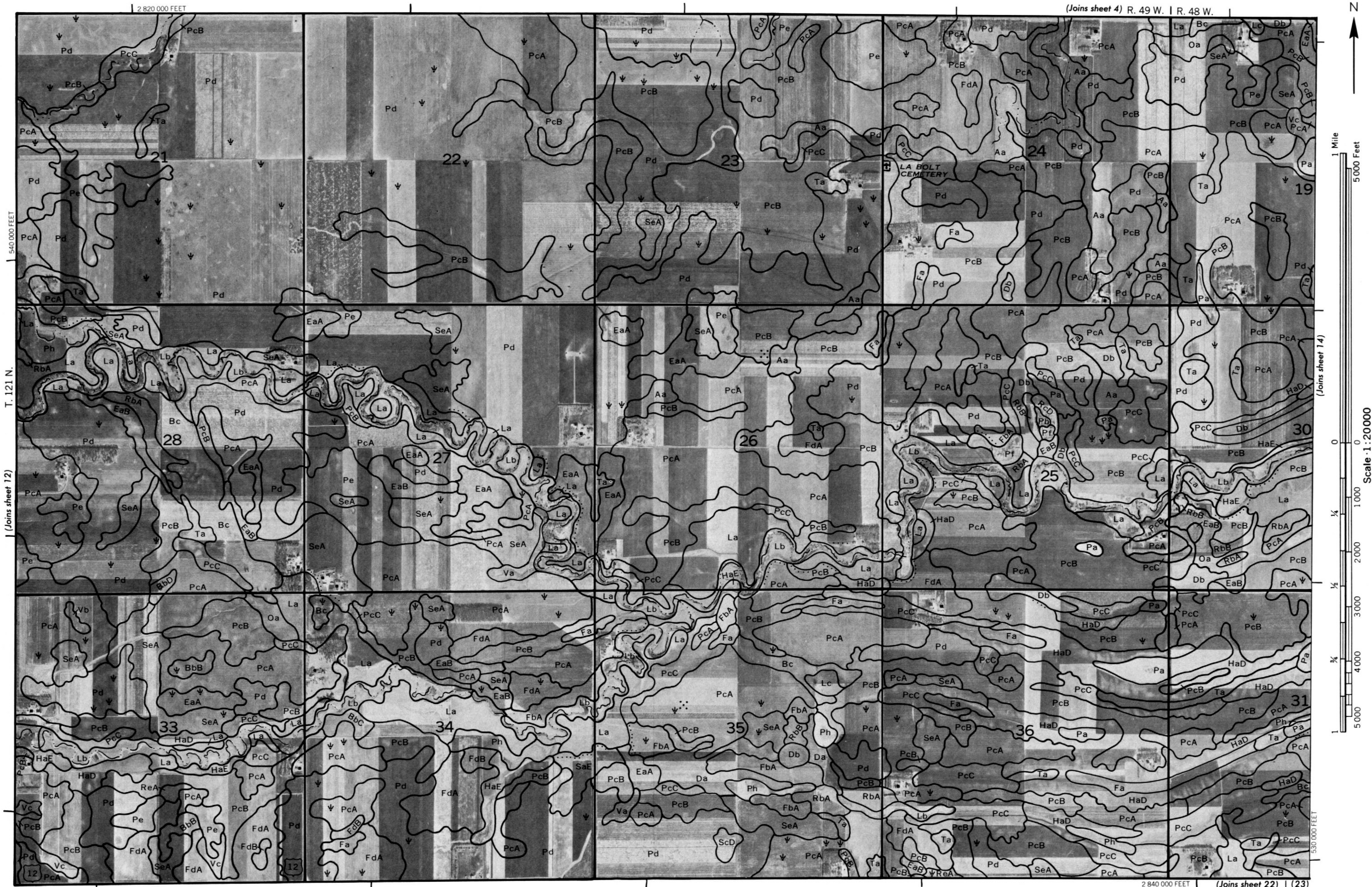

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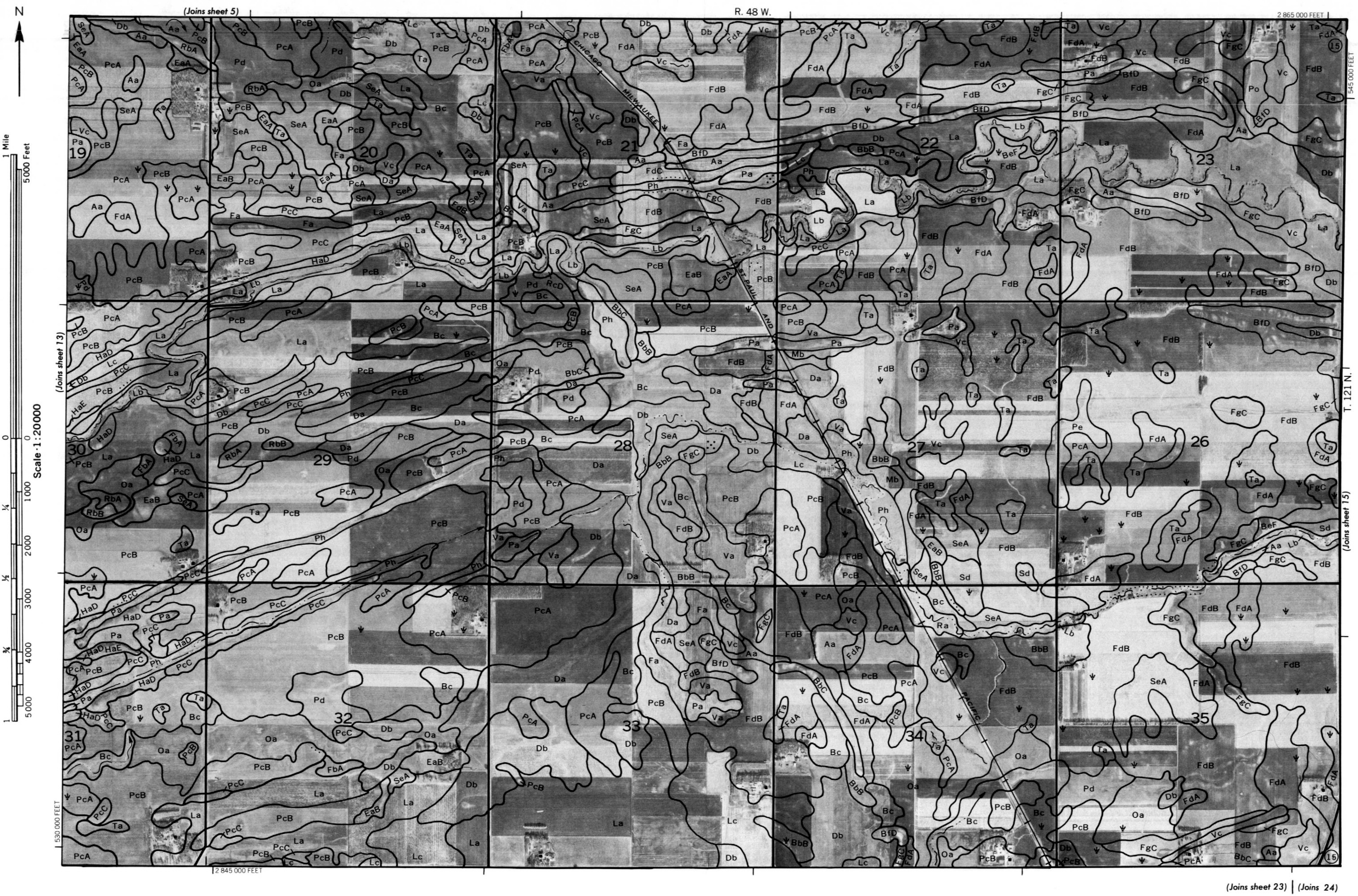
GRANT COUNTY, SOUTH DAKOTA — SHEET NUMBER 14



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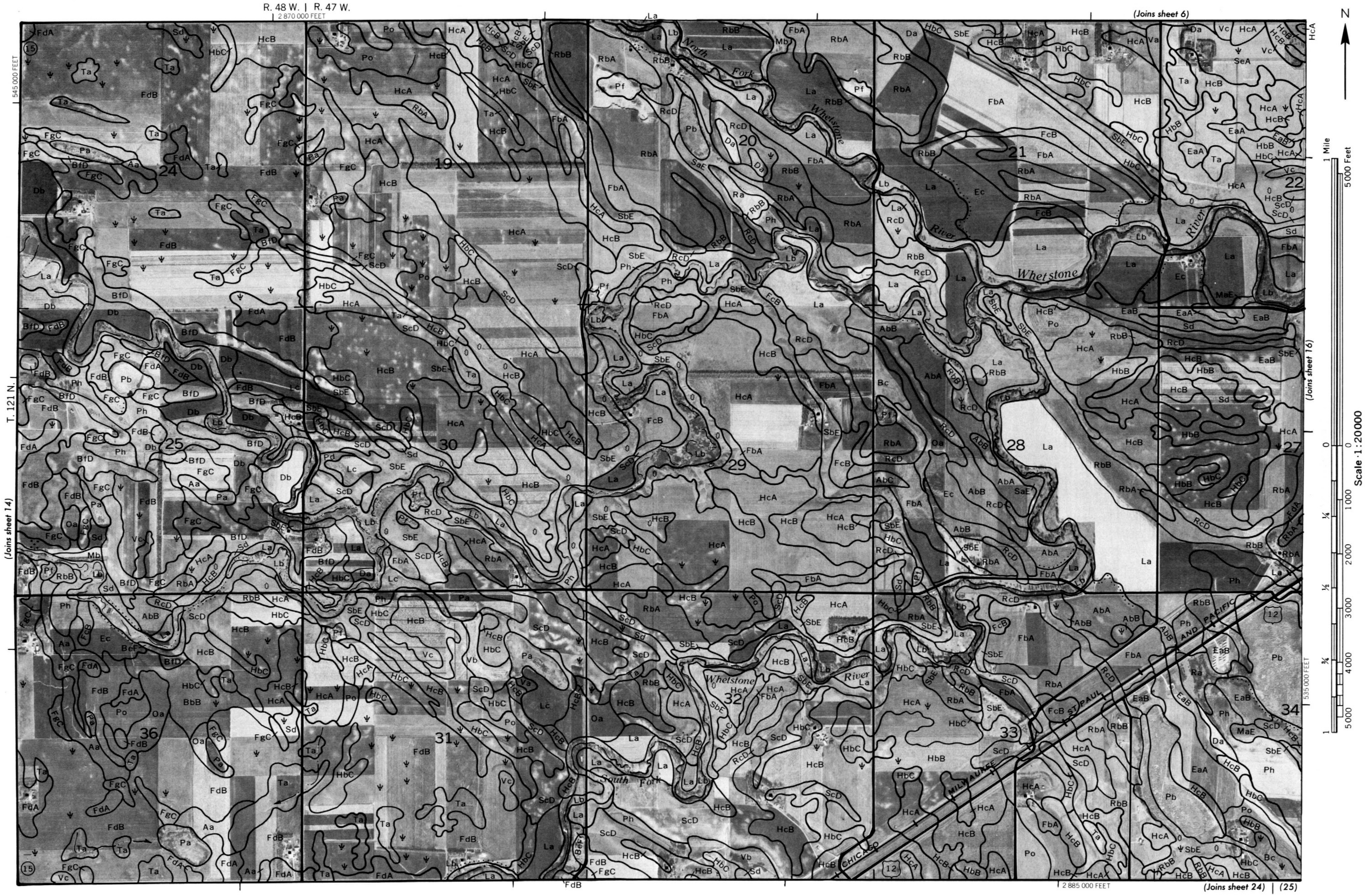

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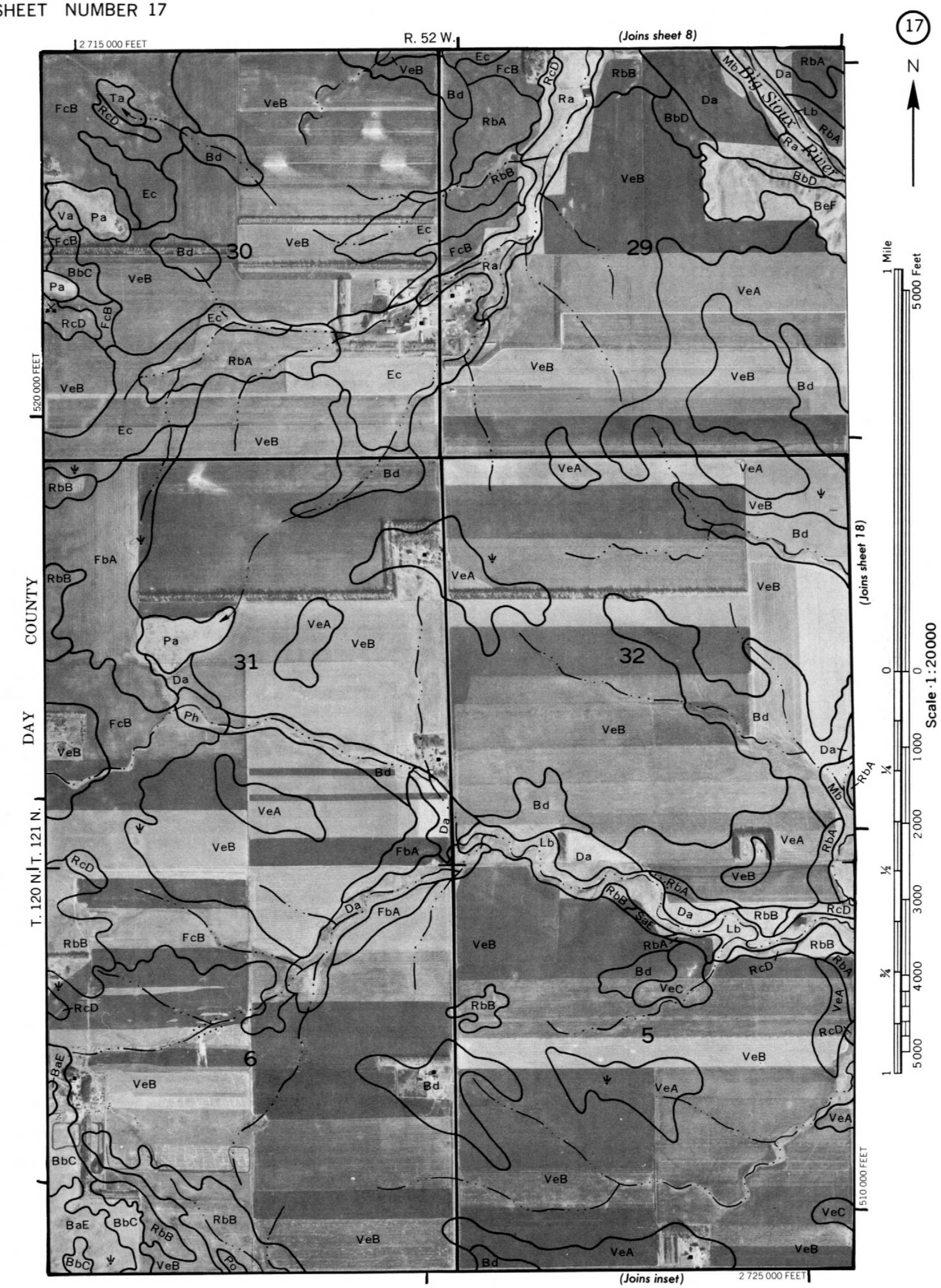
GRANT COUNTY, SOUTH DAKOTA — SHEET NUMBER 16



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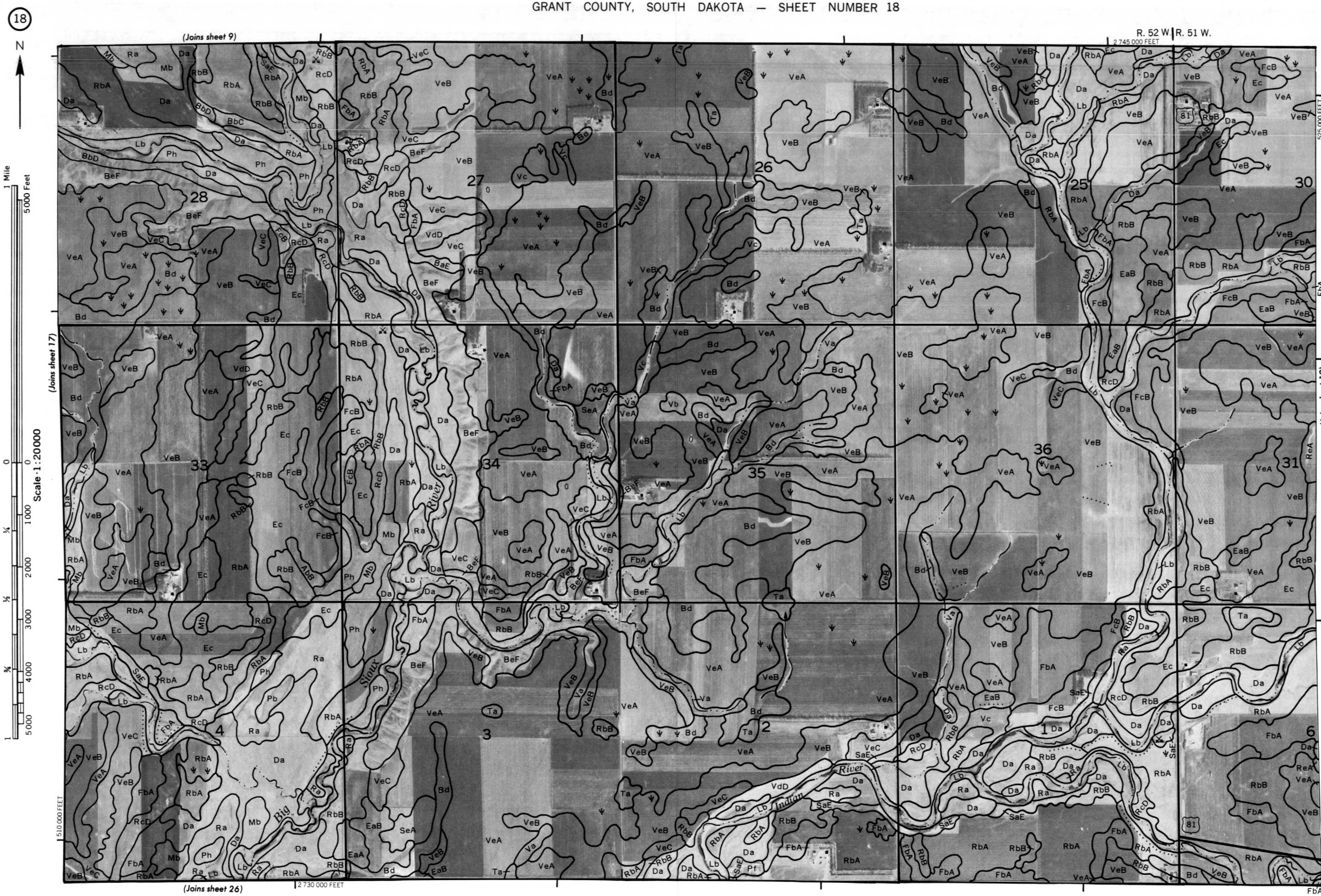

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GRANT COUNTY, SOUTH DAKOTA — SHEET NUMBER 19

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Coordinate grid ticks and land division corners, if shown, are approximately positioned.

(20)

N

1 Mile
5 000 Feet
Scale 1:20000
0 1 000 2 000 3 000 4 000 5 000

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Coordinate grid ticks and land division corners, if shown, are approximately positioned.

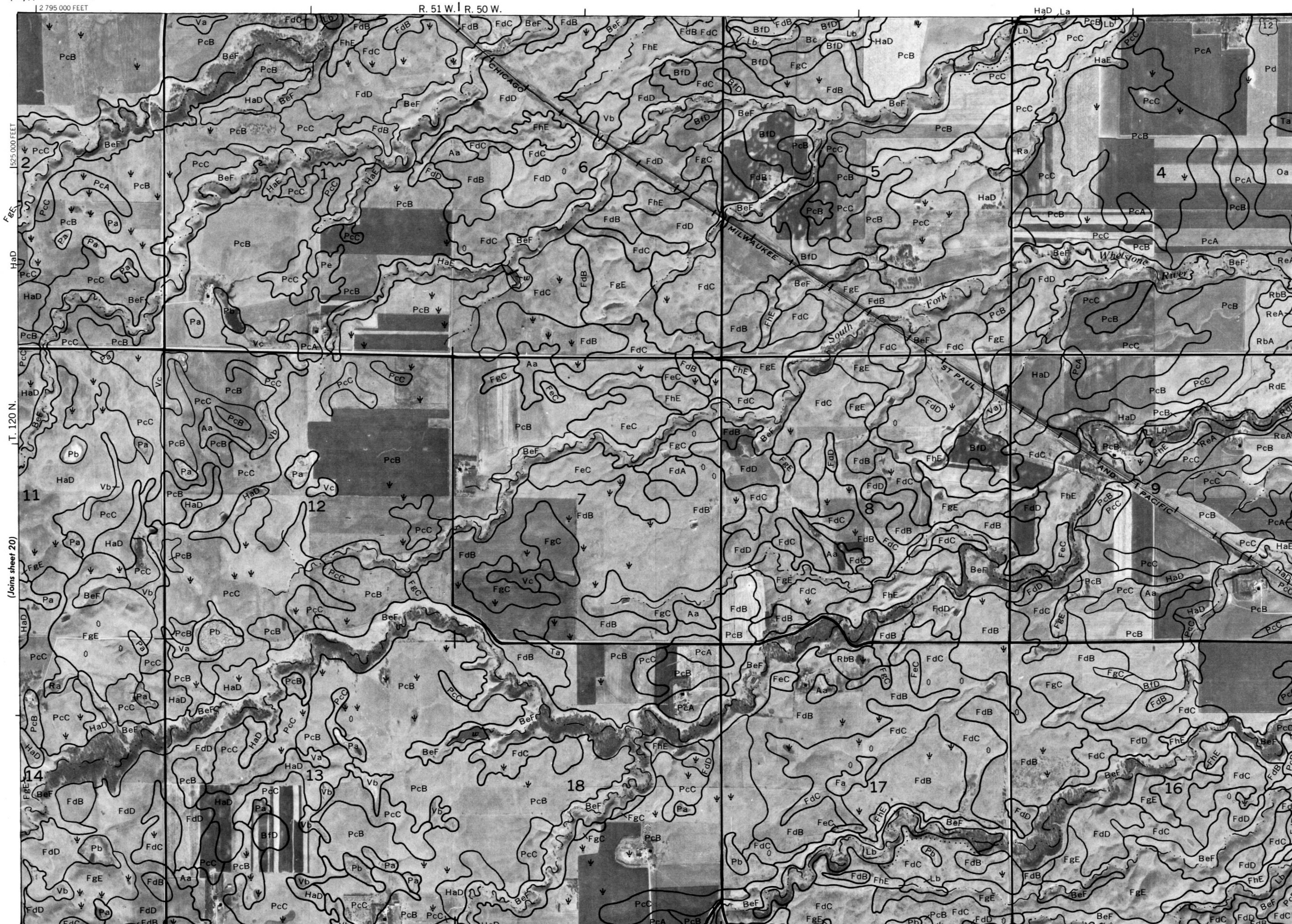
(21)

(11) | (Joins sheet 12)

2 795 000 FEET

R. 51 W. | R. 50 W.

N



T. 120 N.

(Joins sheet 20)

(Joins sheet 22)

(Joins sheet 29)

525 000 FEET

515 000 FEET

2 815 000 FEET

Scale 1:20000

1 Mile — ¾ — ½ — ¼ — 0

5000 Feet — 4000 — 3000 — 2000 — 1000 — 0 — 5000

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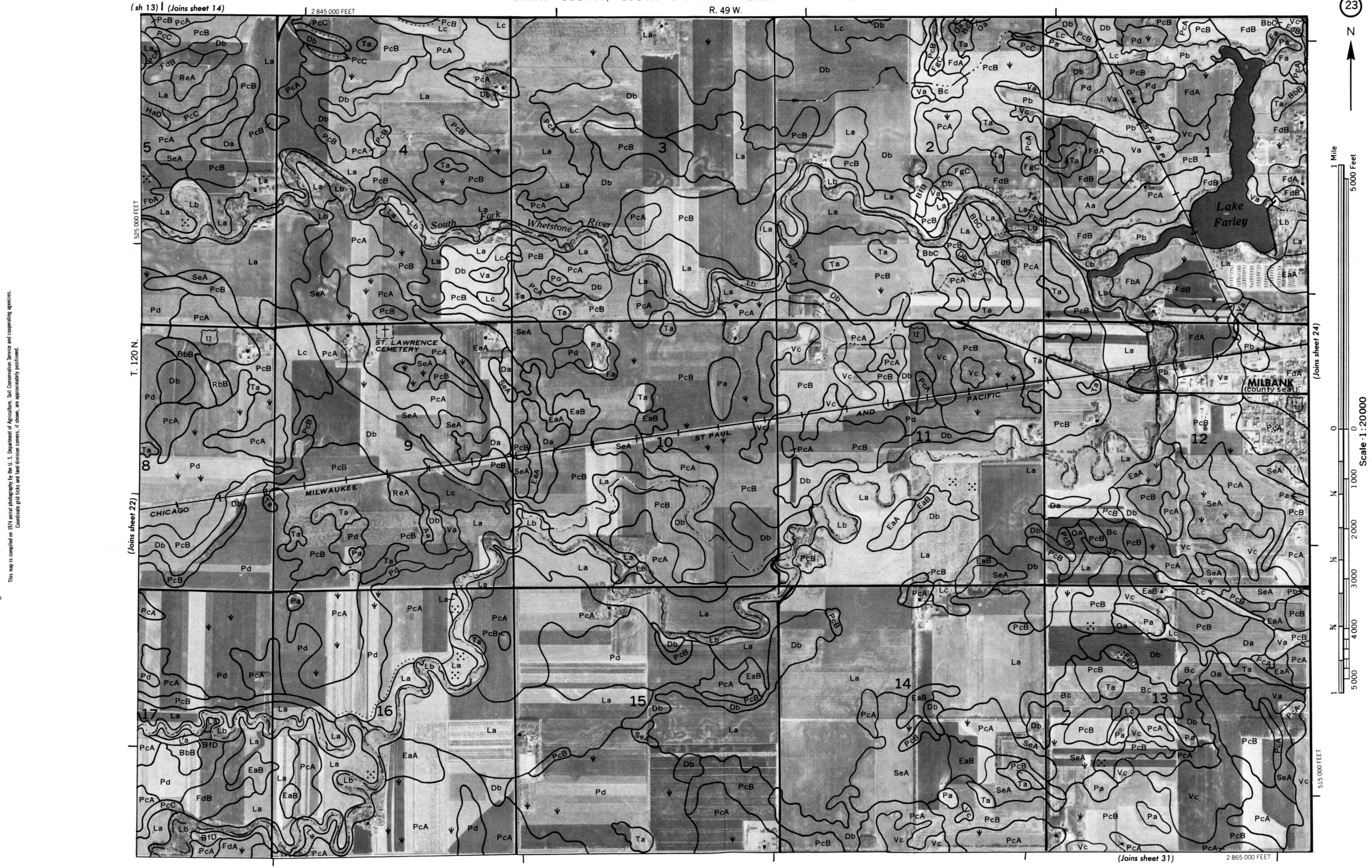
GRANT COUNTY, SOUTH DAKOTA — SHEET NUMBER 23



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(15) | (Joins sheet 16)

(25)

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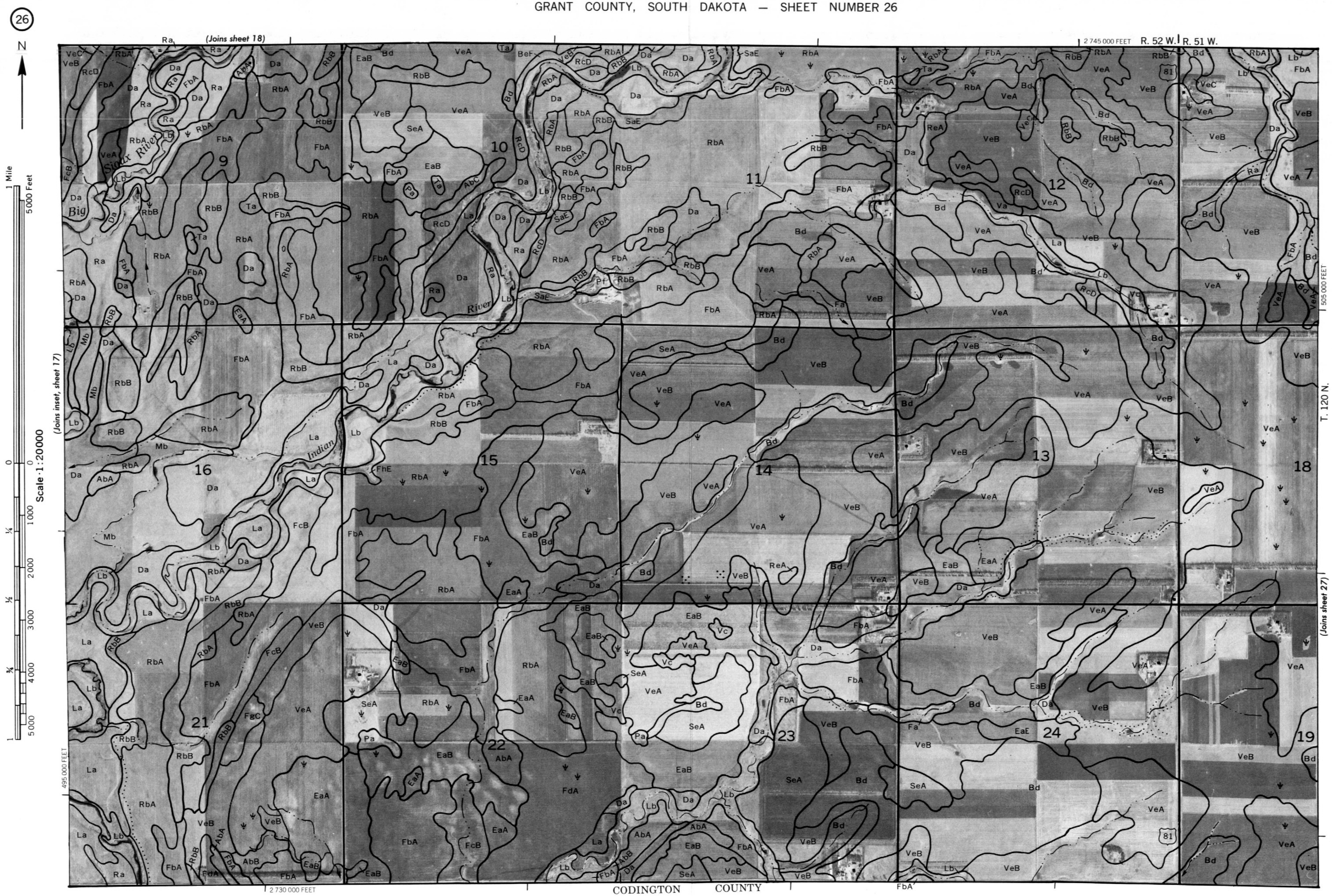

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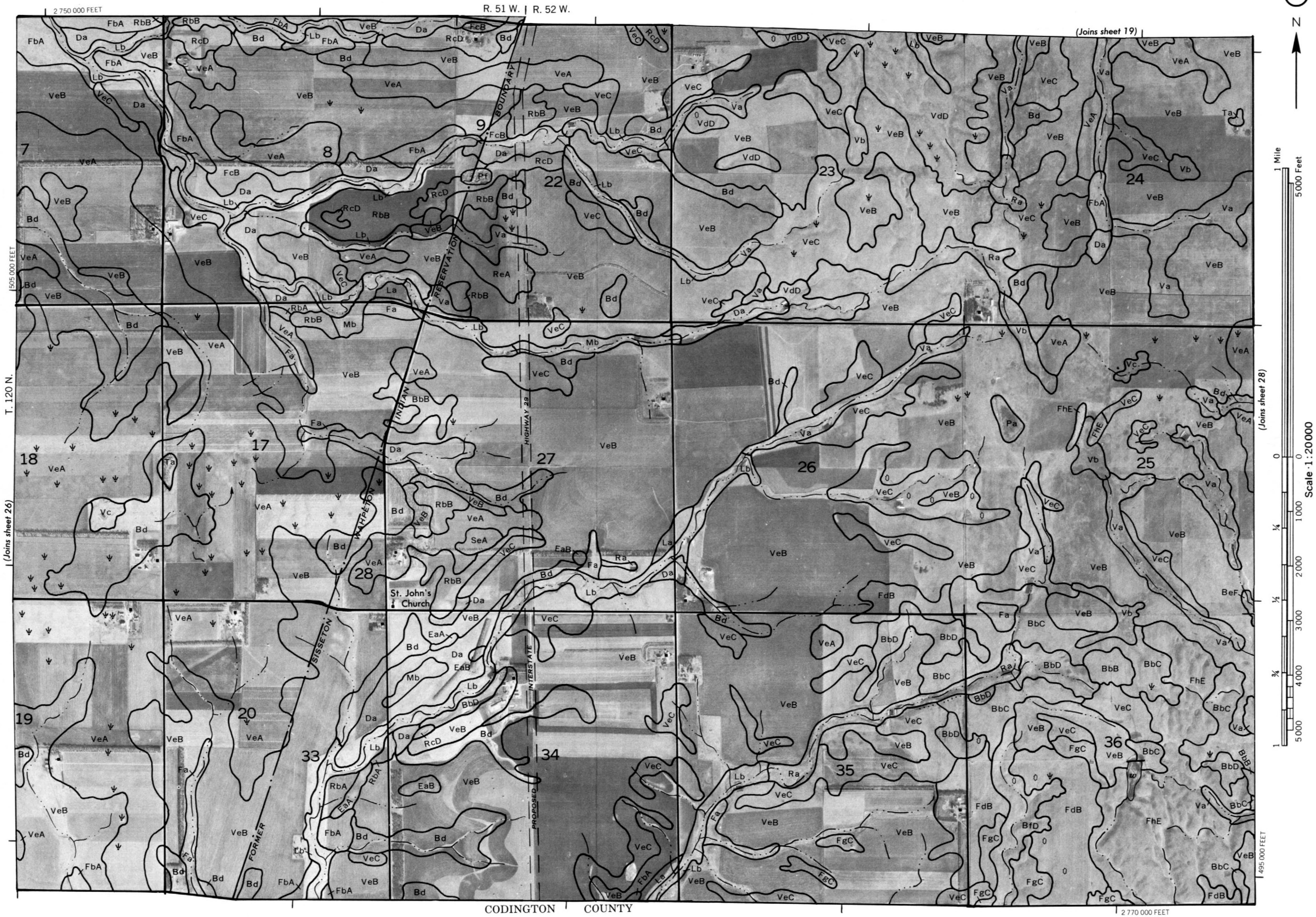

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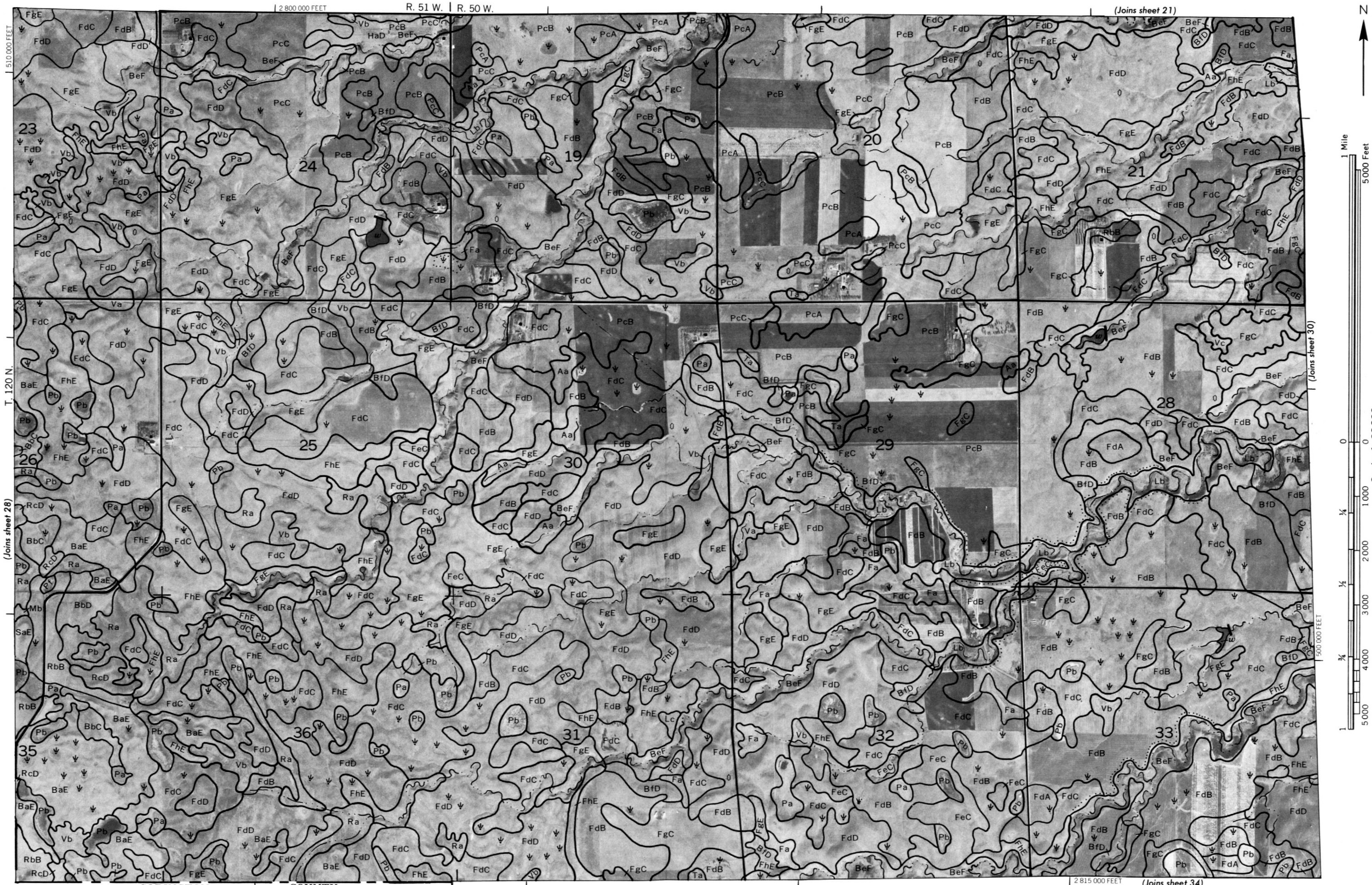
29
N
(Joins sheet 21)
(Joins sheet 30)
(Joins sheet 34)
(Joins sheet 28)
R. 51 W.
R. 50 W.
T. 120 N.
2 800 000 FEET
2 815 000 FEET
510 000 FEET
500 000 FEET
CODINGTON COUNTY
1 Mile
5000 Feet
Scale 1:20000
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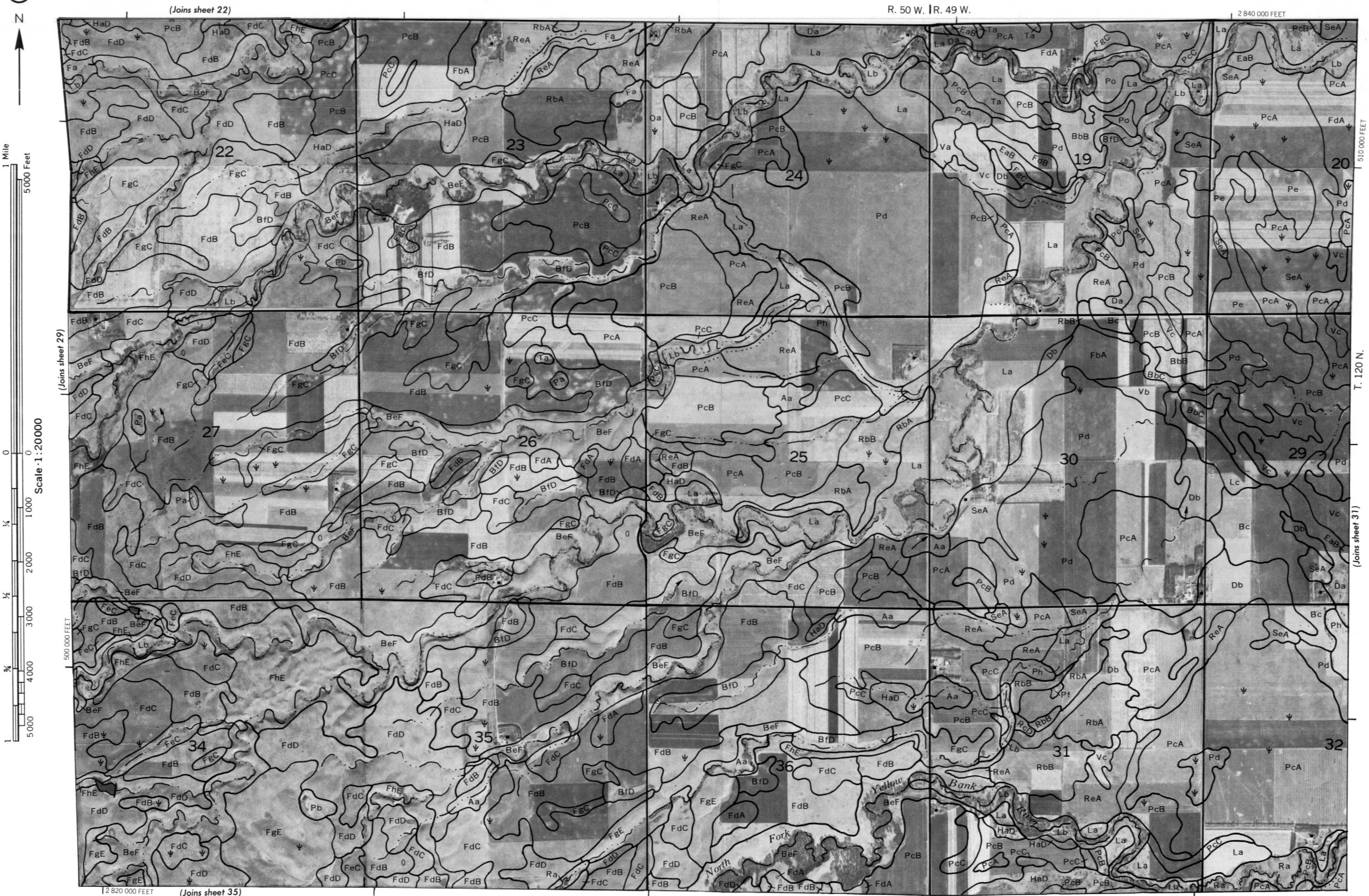

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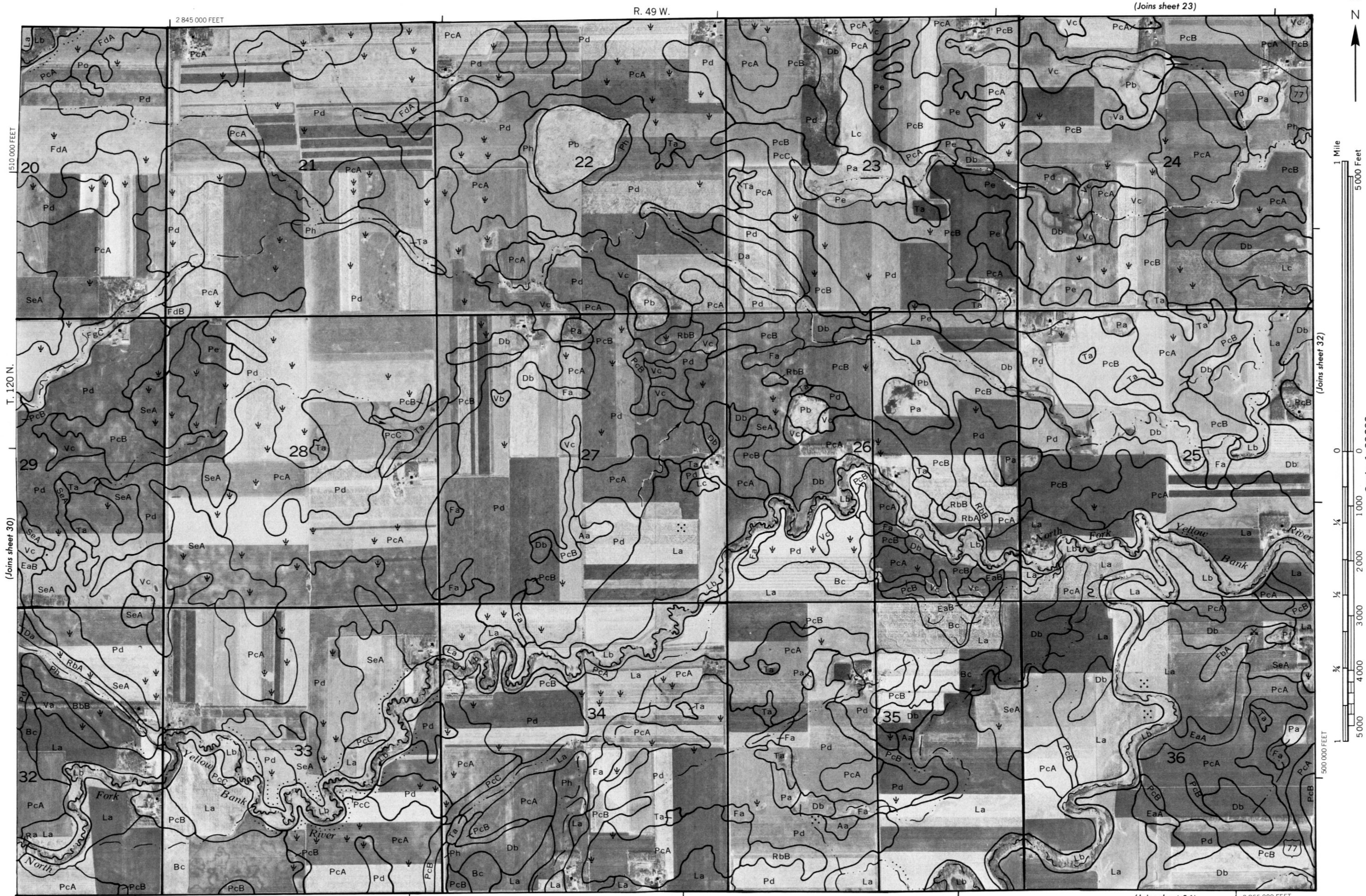

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Coordinate grid ticks and land division corners, if shown, are approximately positioned.

(32)

GRANT COUNTY, SOUTH DAKOTA — SHEET NUMBER 32

N

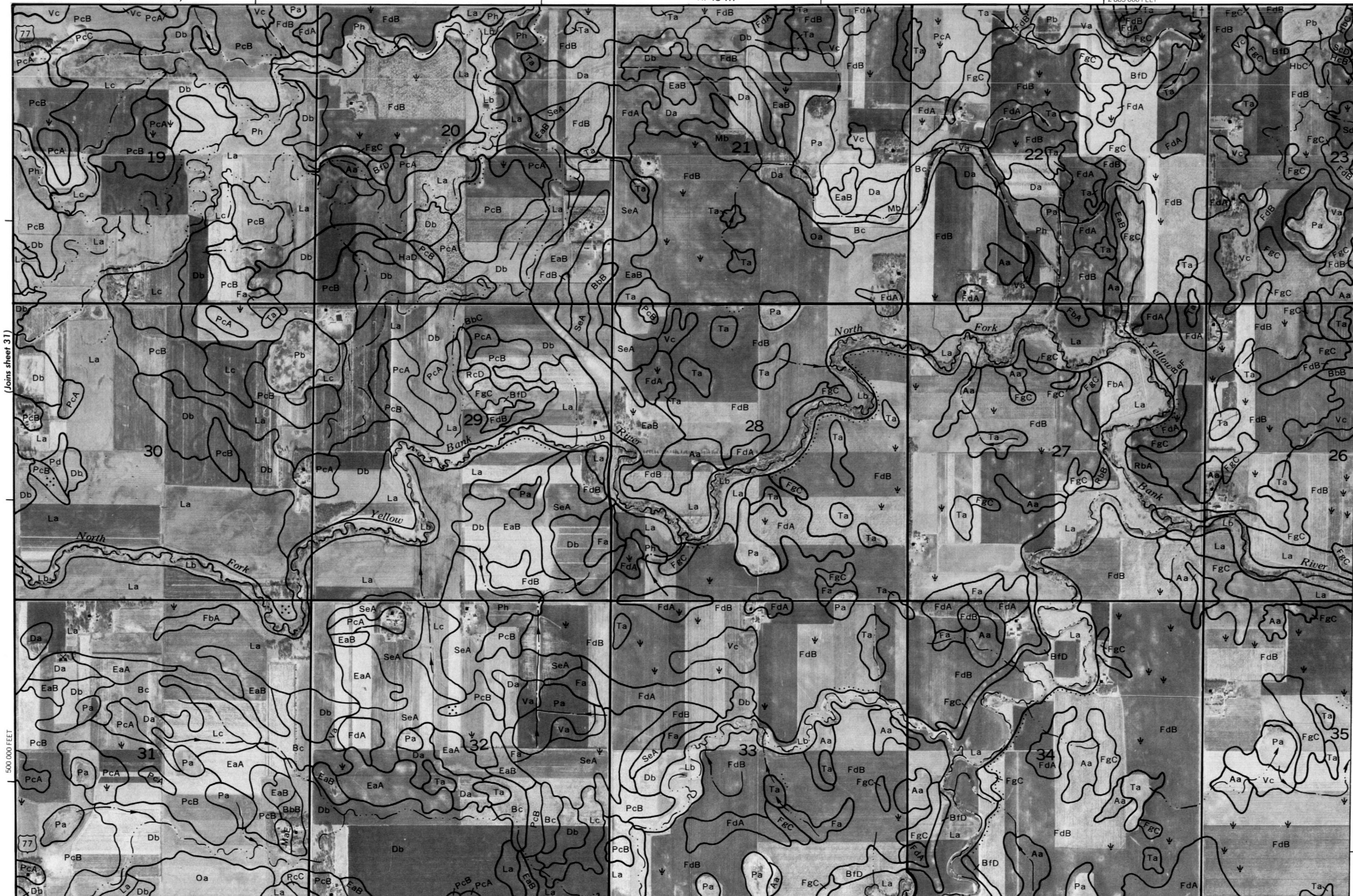
(Joins sheet 24)

R. 48 W.

2 885 000 FEET

515 000 FEET

(Joins sheet 31)



T. 120 N.

(Joins sheet 33)

500 000 FEET

(Joins sheet 37)

2 870 000 FEET

1 Mile

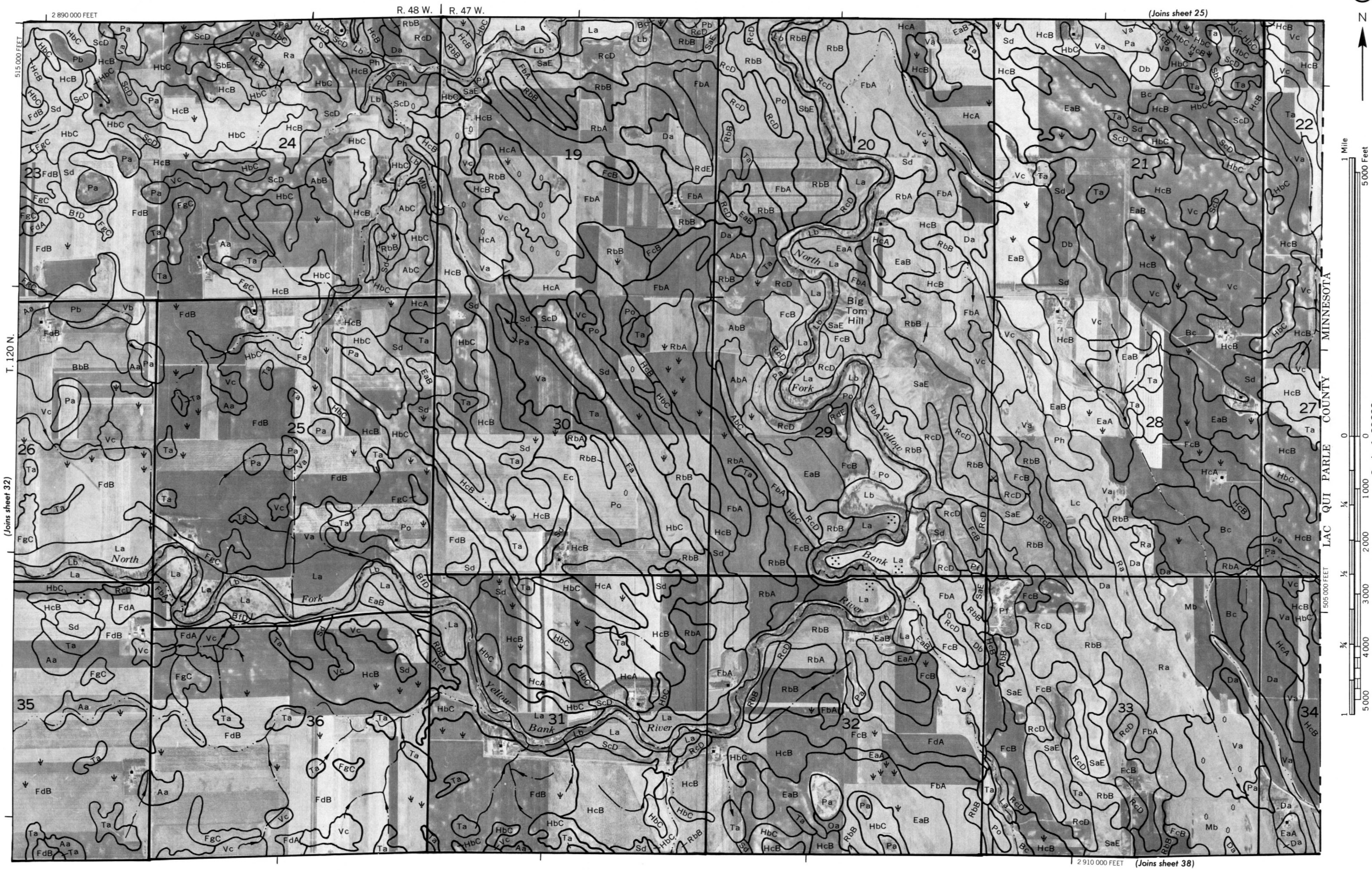
5000 Feet

Scale 1:20000

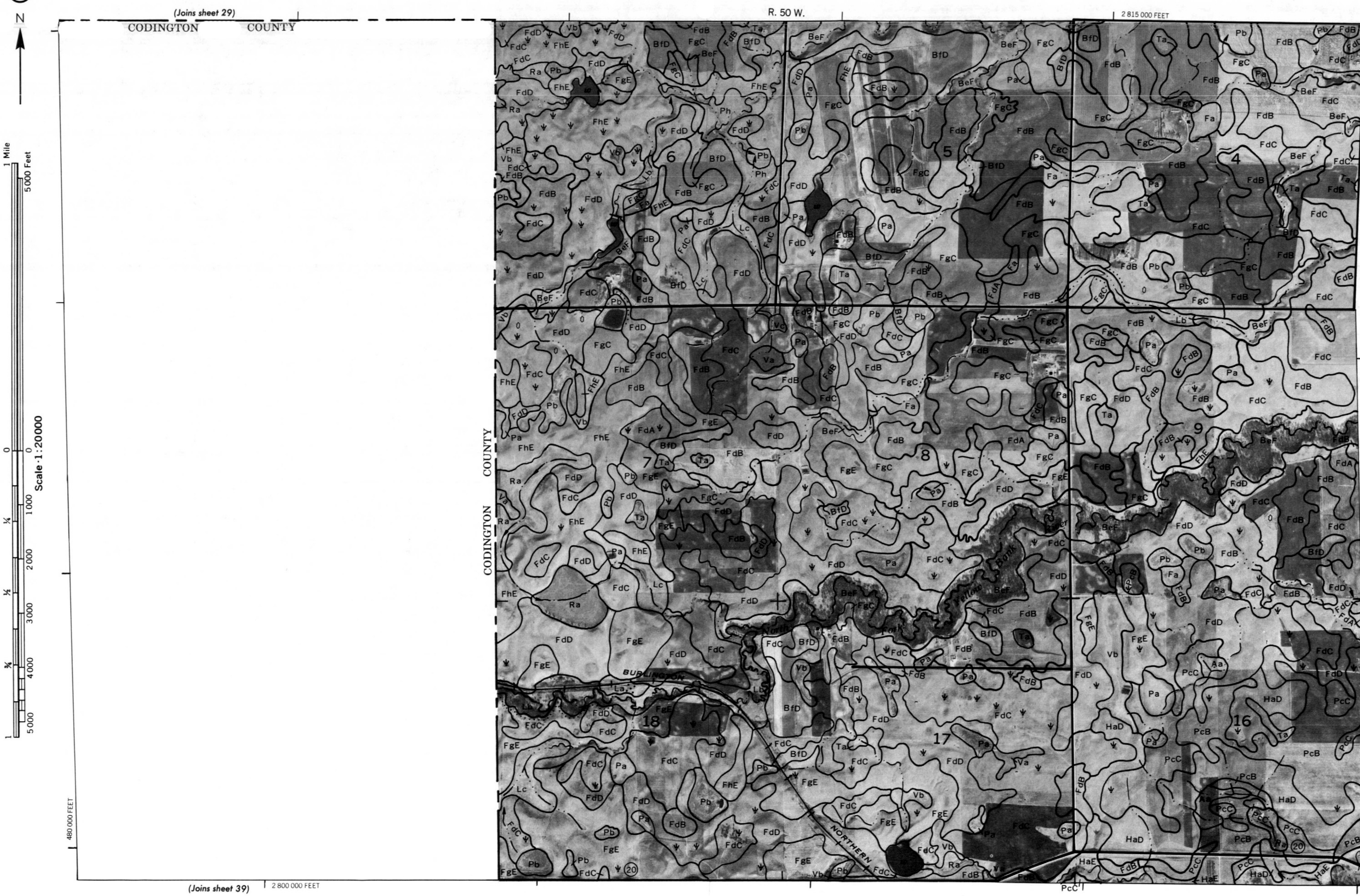
0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

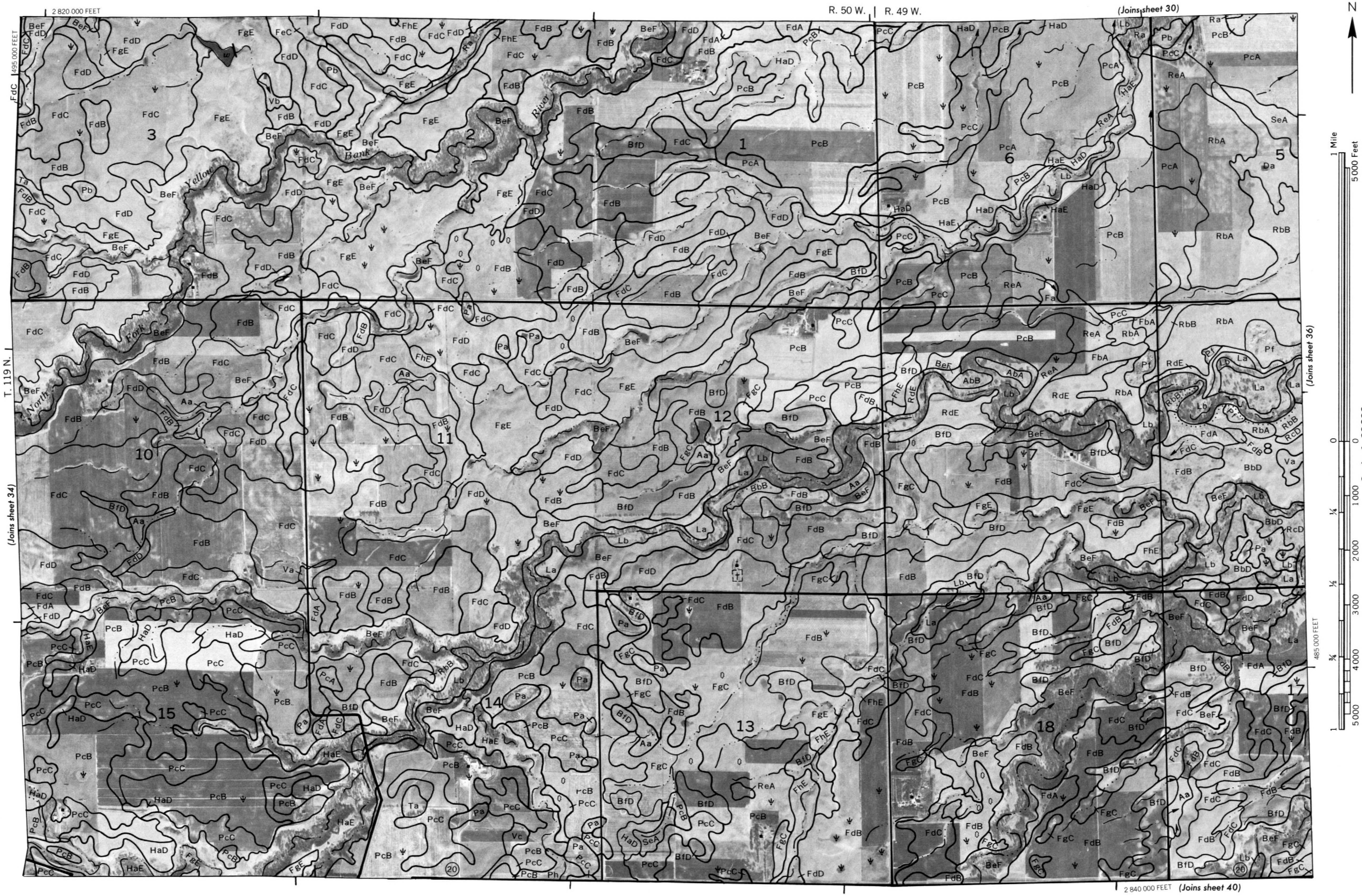
This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

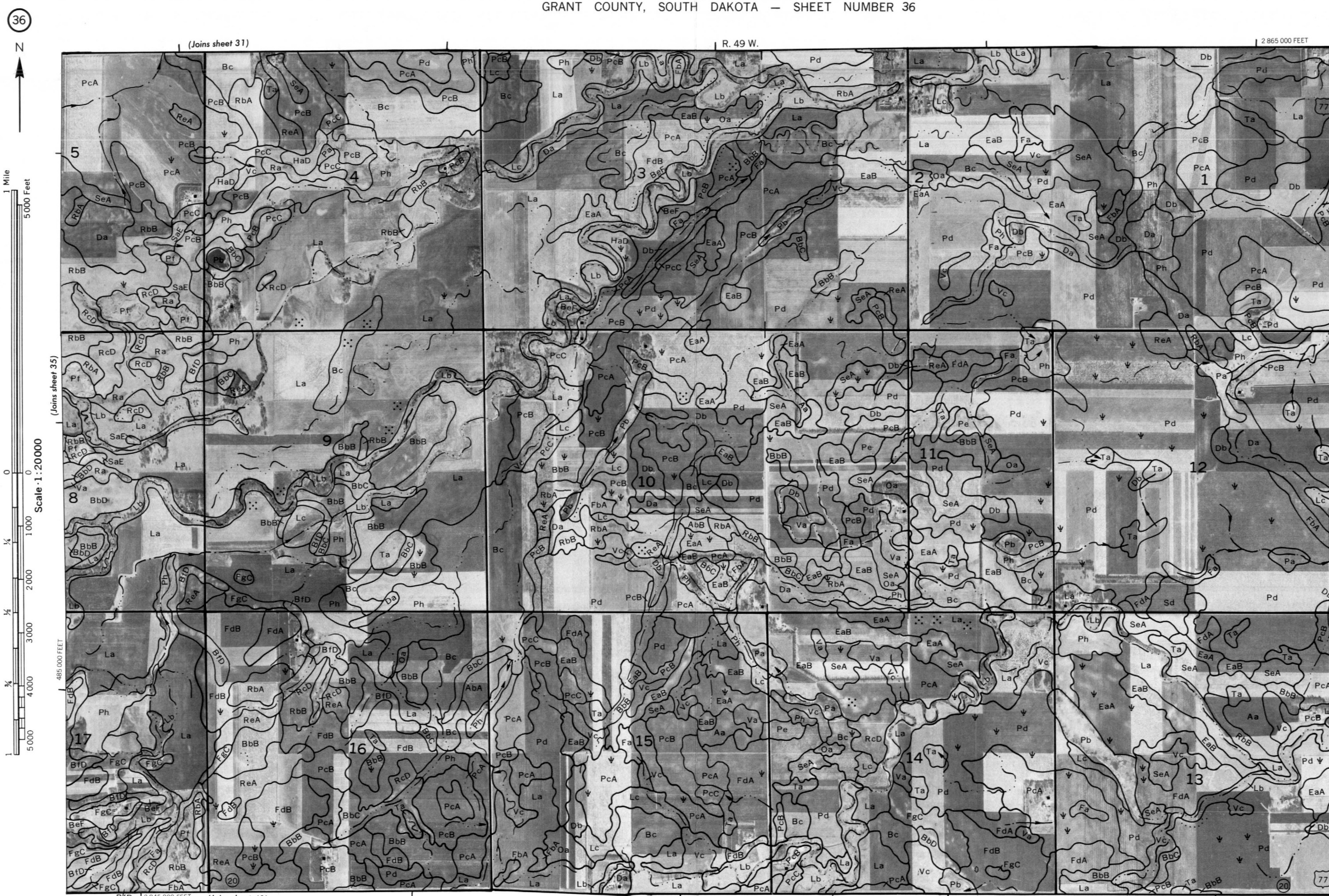


This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

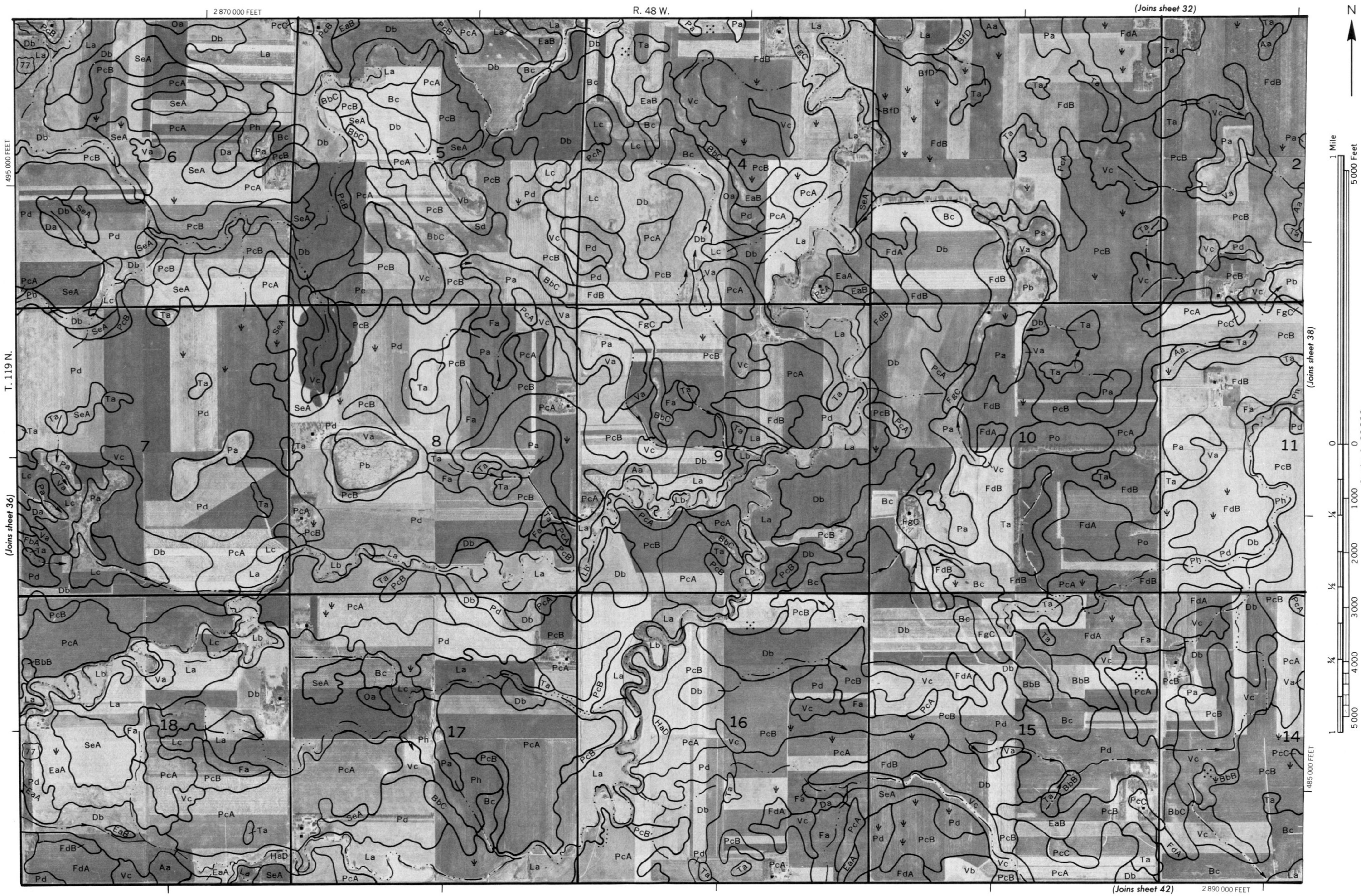


This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

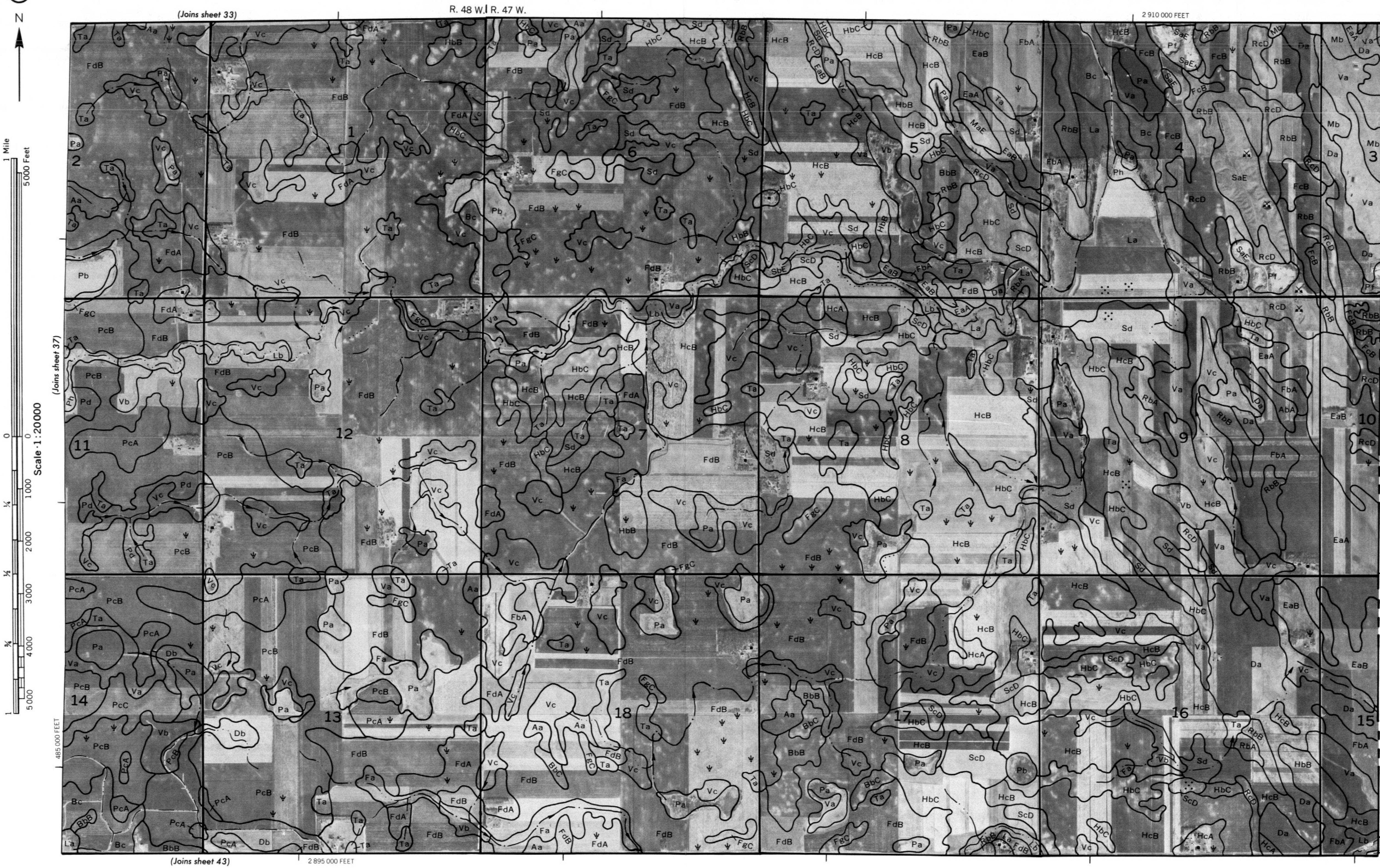
GRANT COUNTY, SOUTH DAKOTA — SHEET NUMBER 36



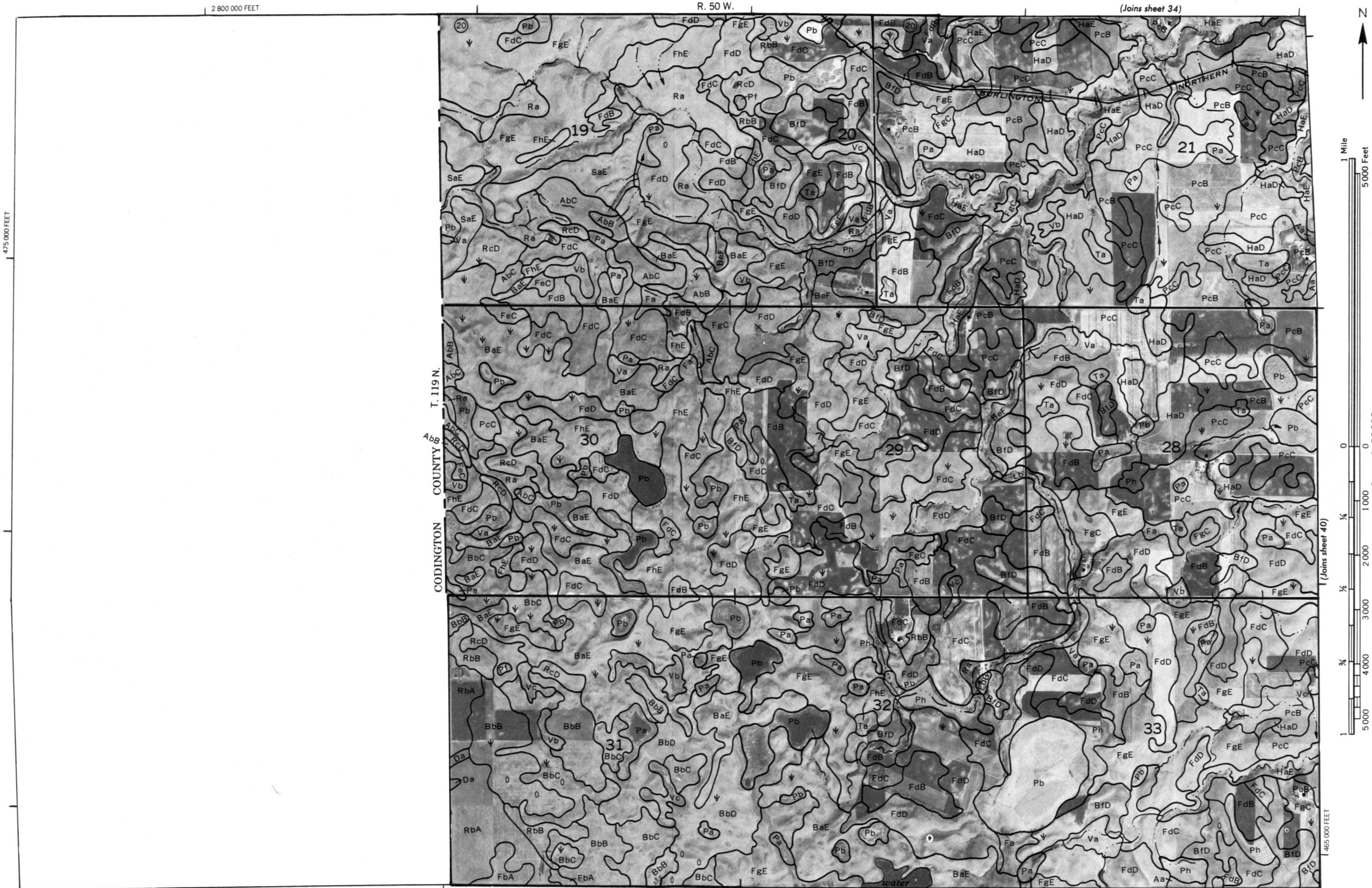
This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



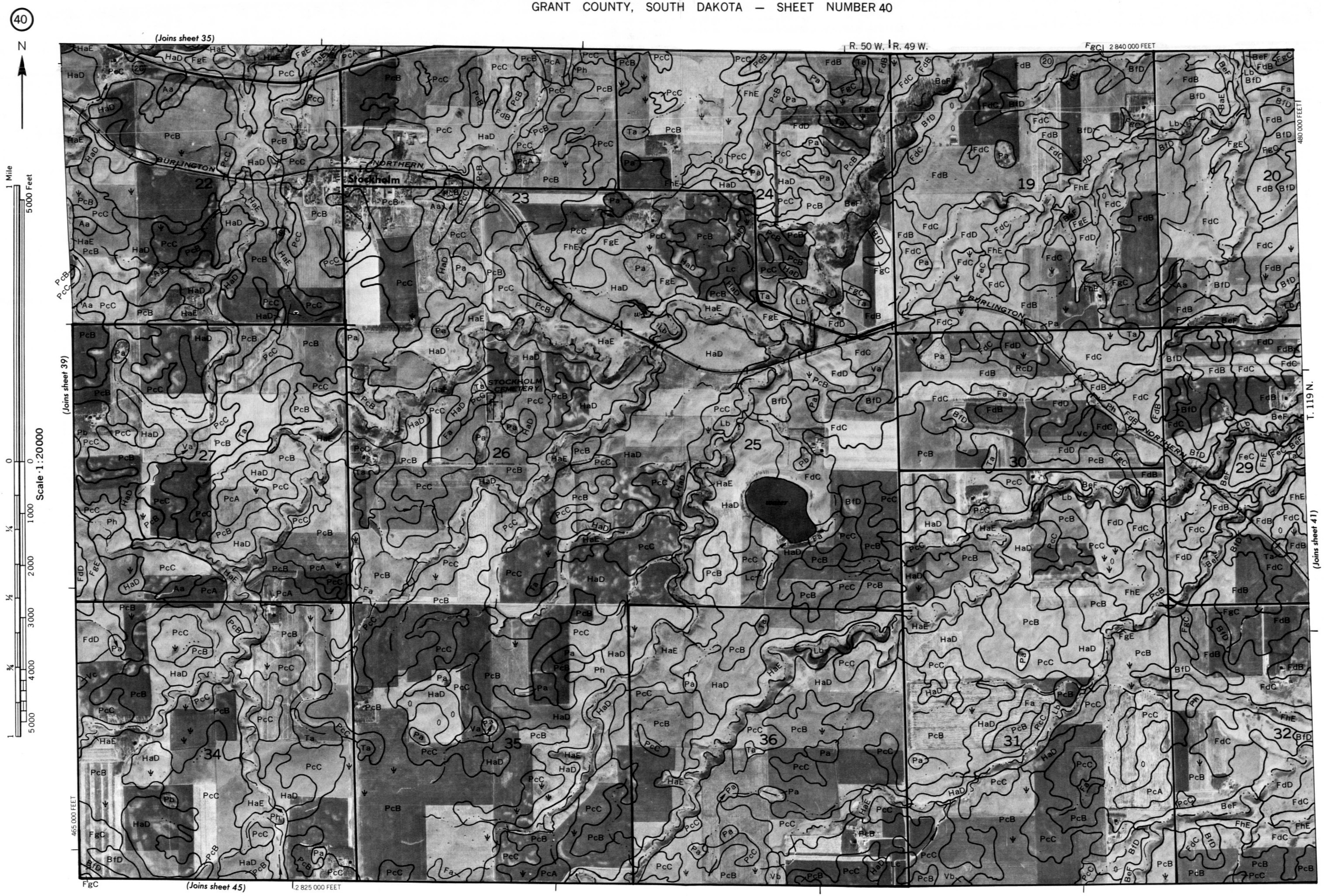
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



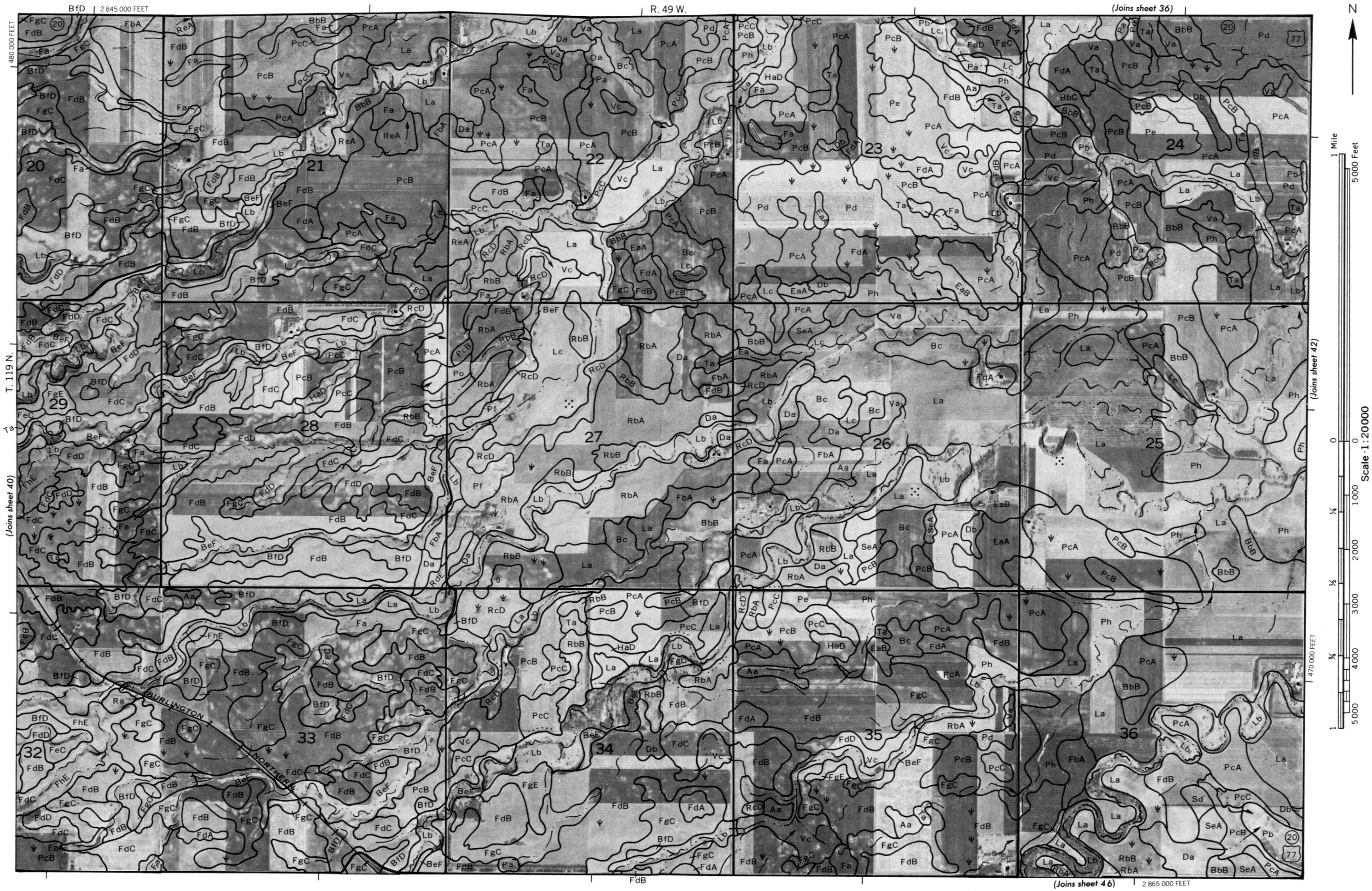
This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

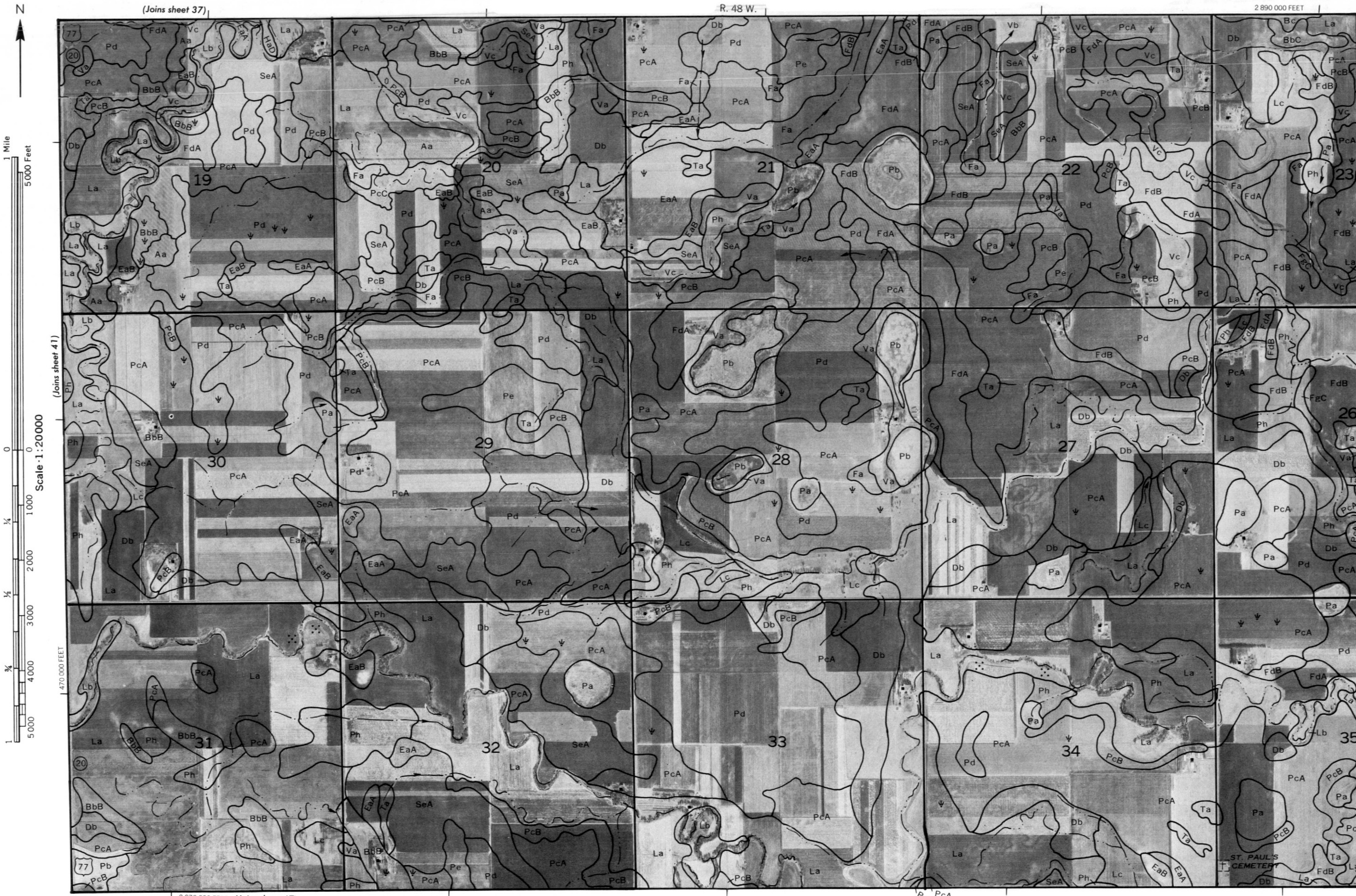


This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

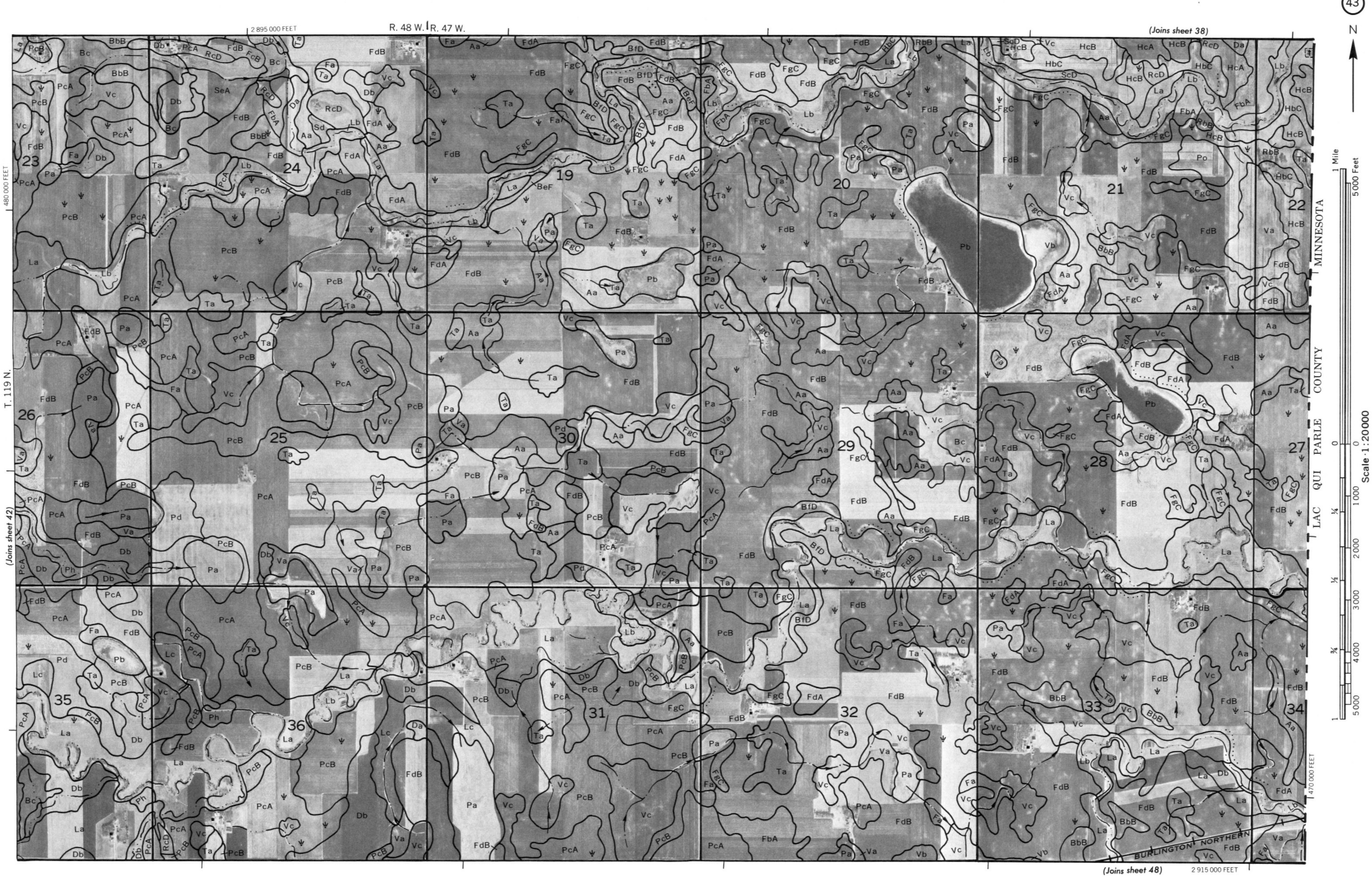


This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

GRANT COUNTY, SOUTH DAKOTA — SHEET NUMBER 42



This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

44

N

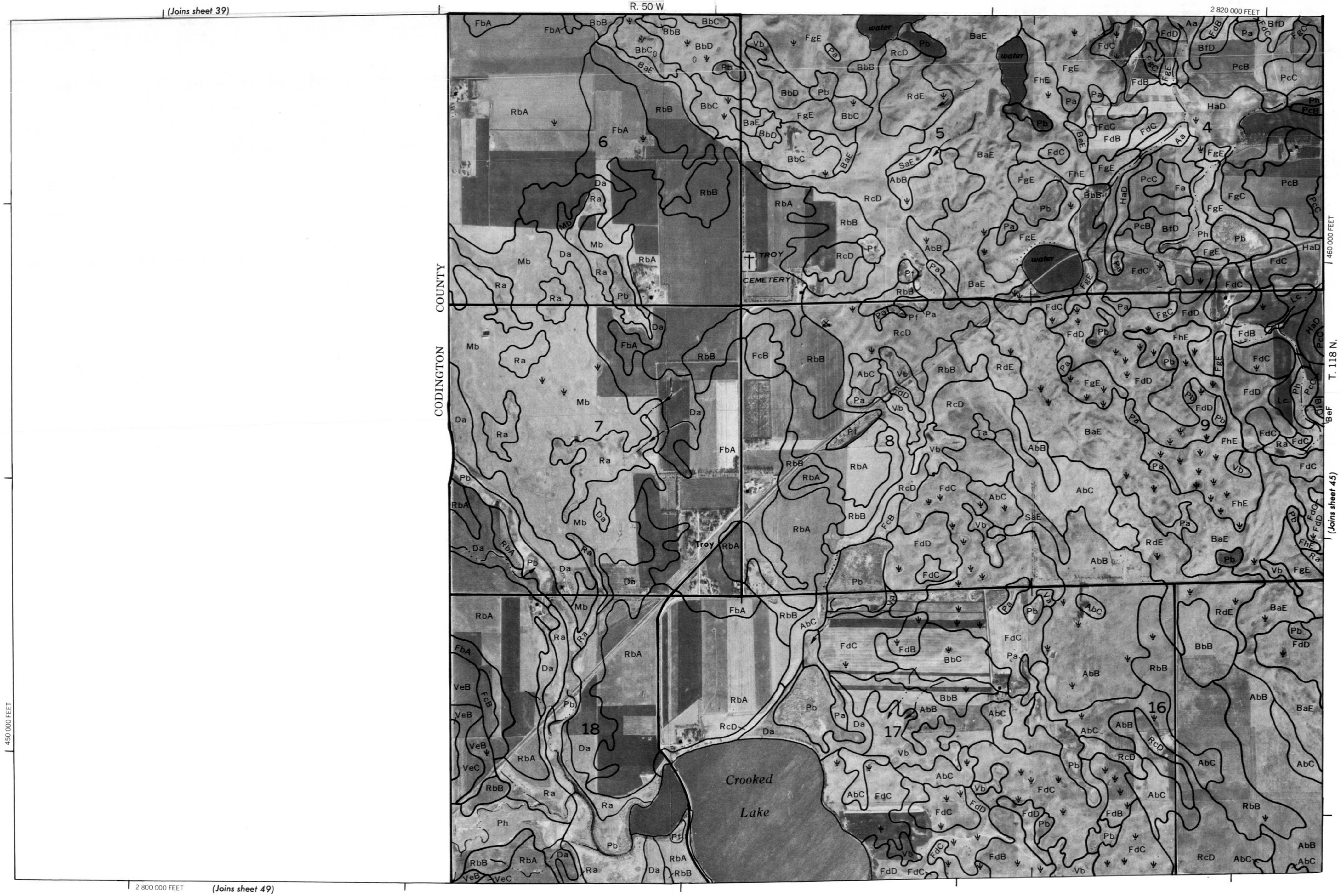
1 Mile

5 000 Feet

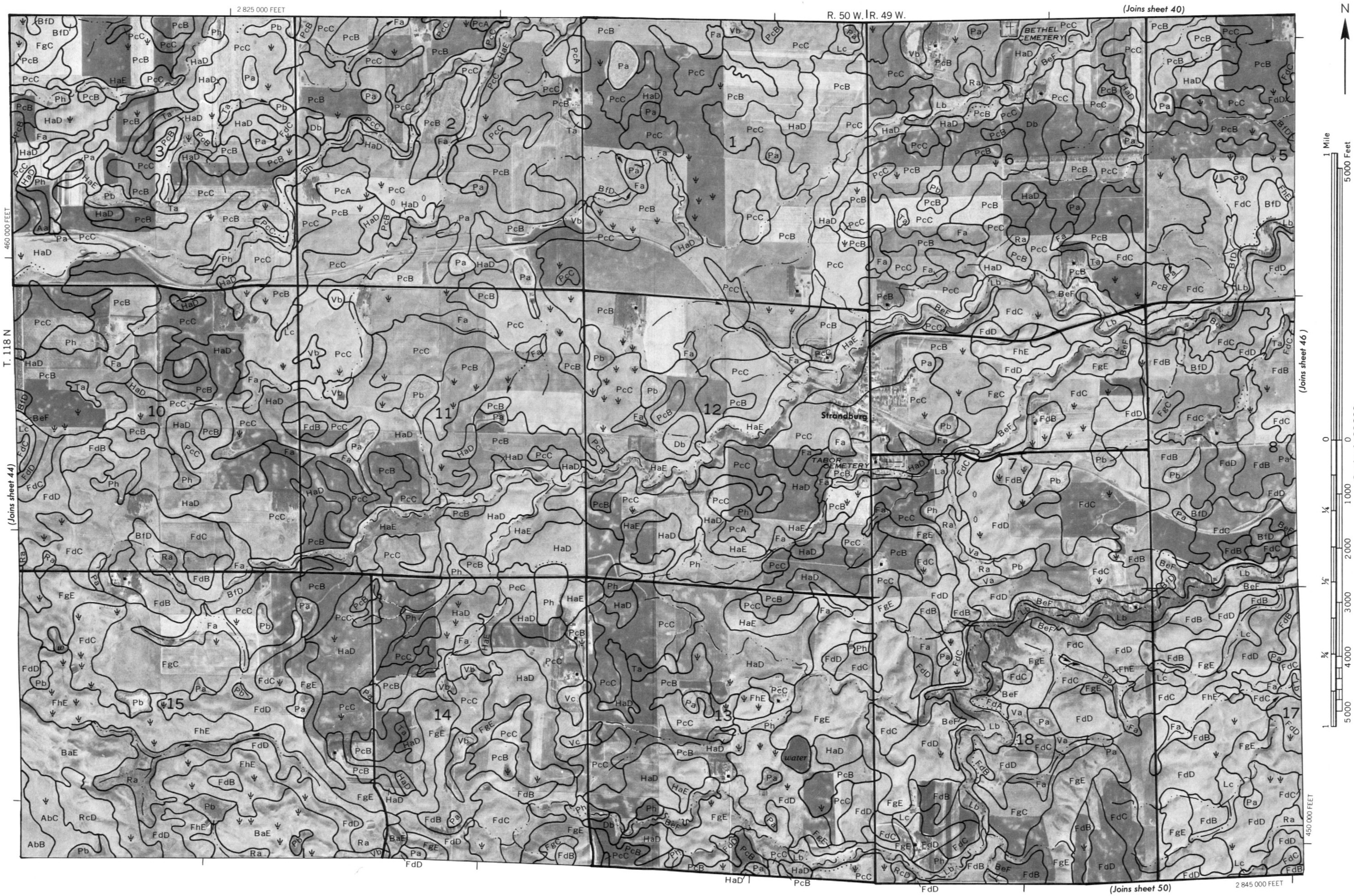
Scale 1:20000

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000



This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

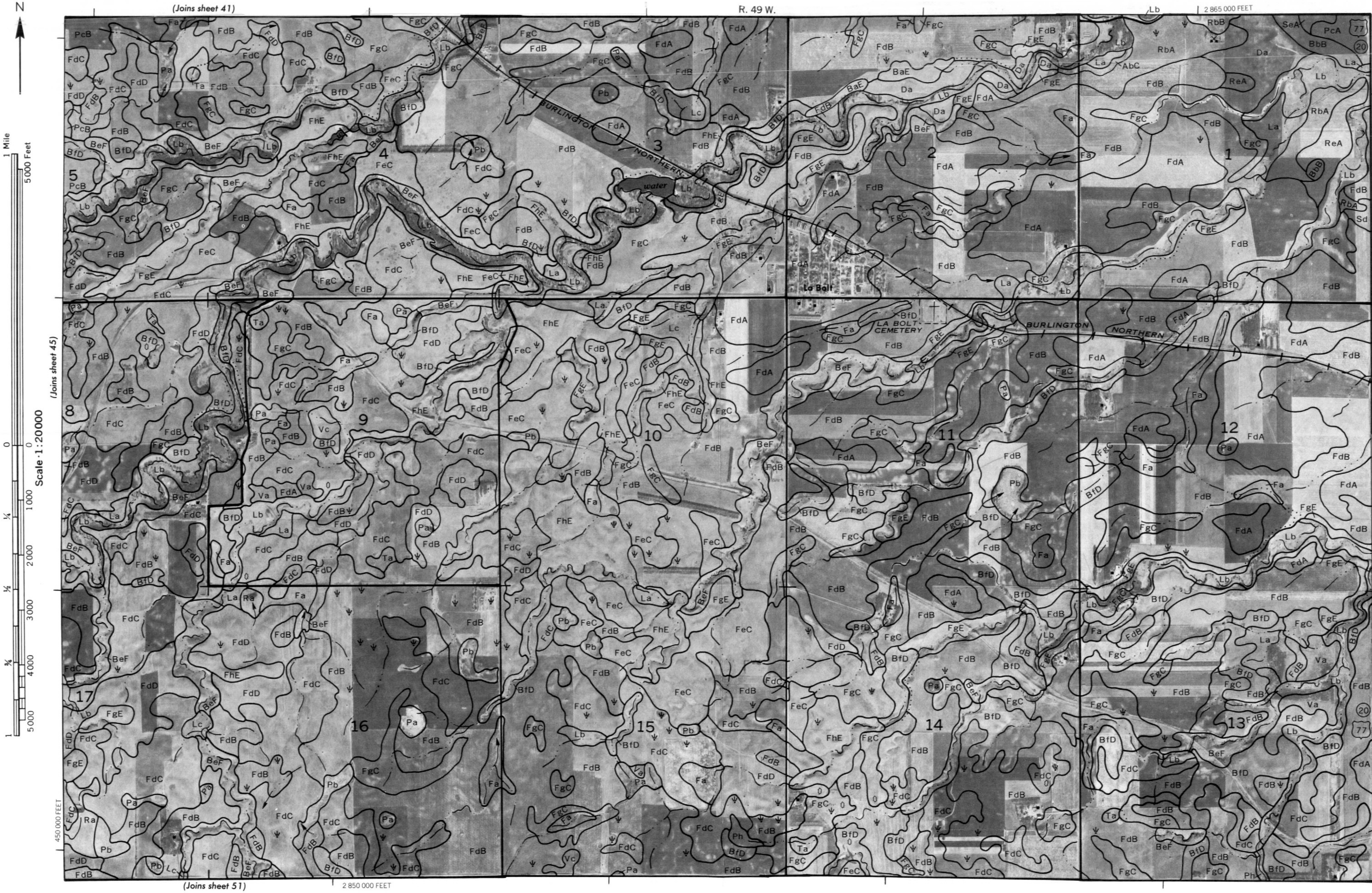


This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

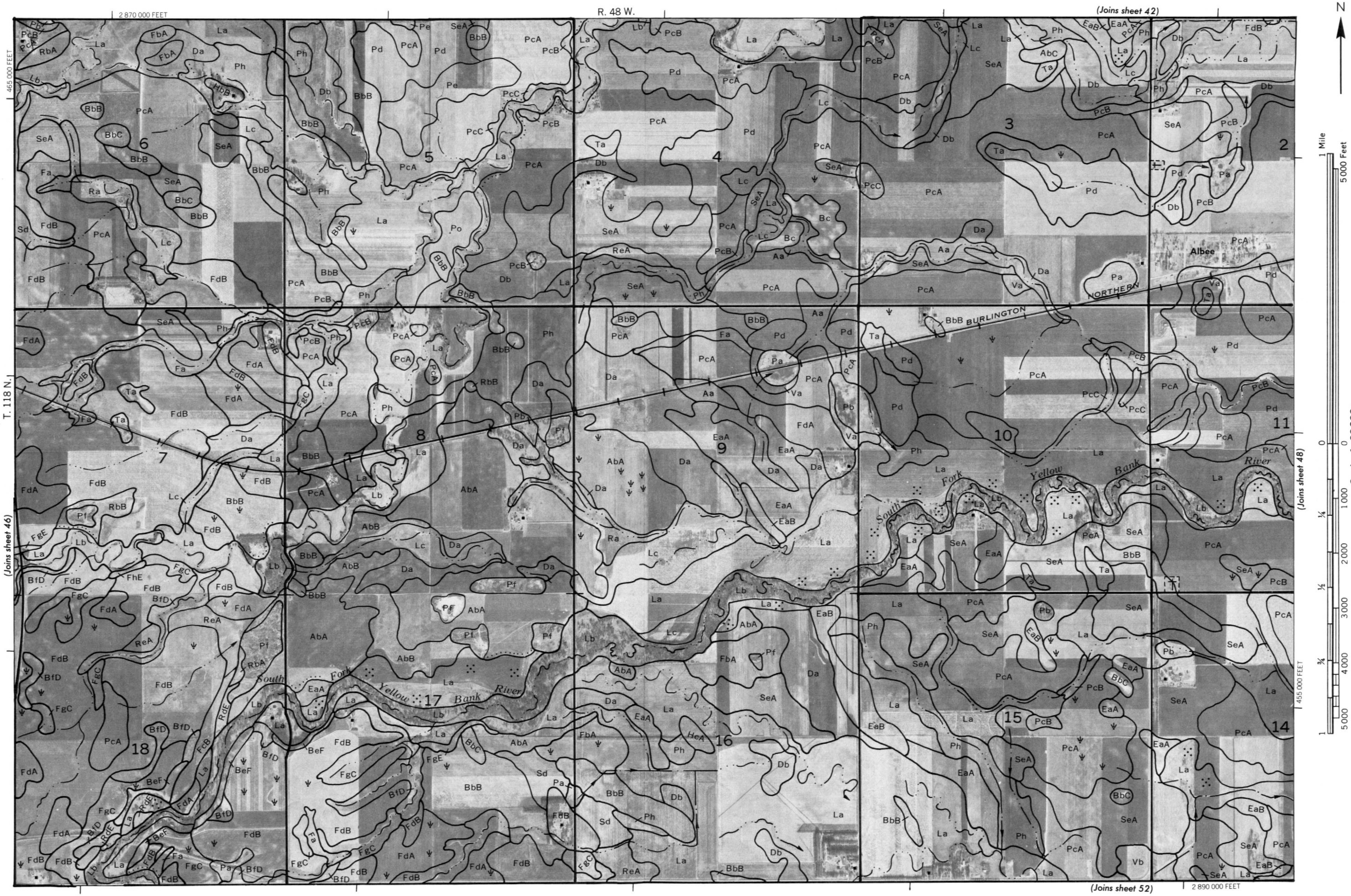
GRANT COUNTY, SOUTH DAKOTA — SHEET NUMBER 46

N

Scale 1:20000



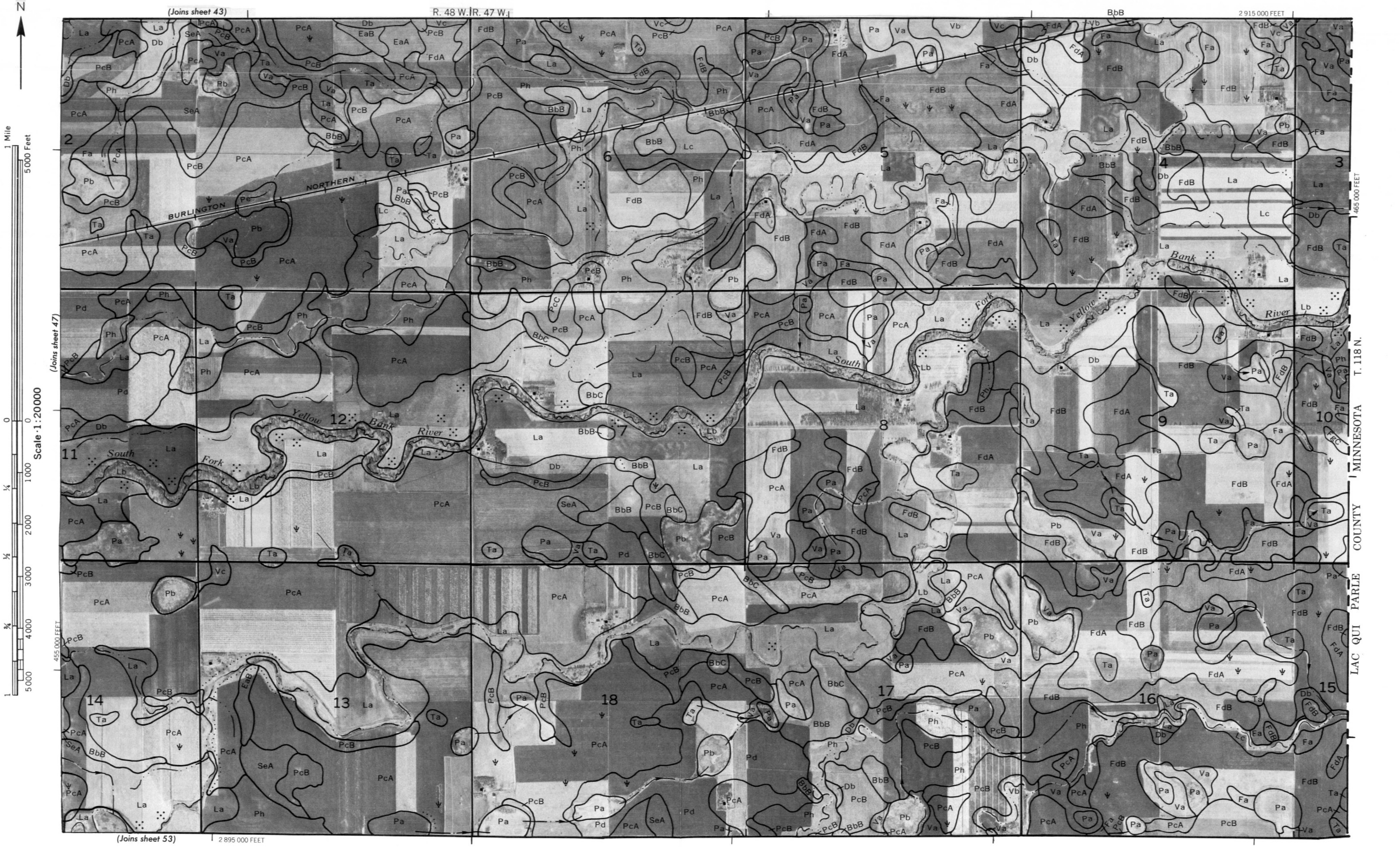
This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

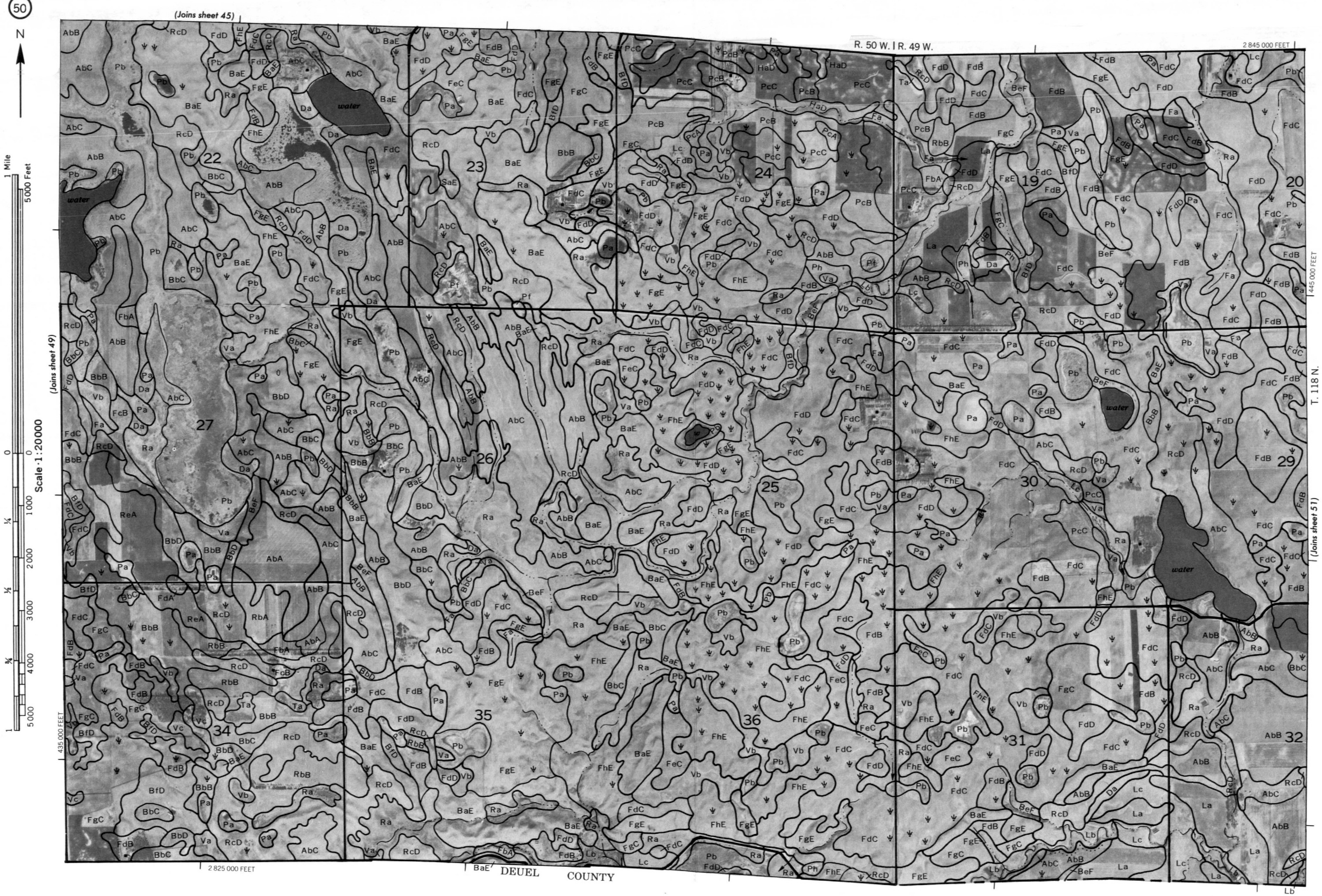
(48)

GRANT COUNTY, SOUTH DAKOTA — SHEET NUMBER 48

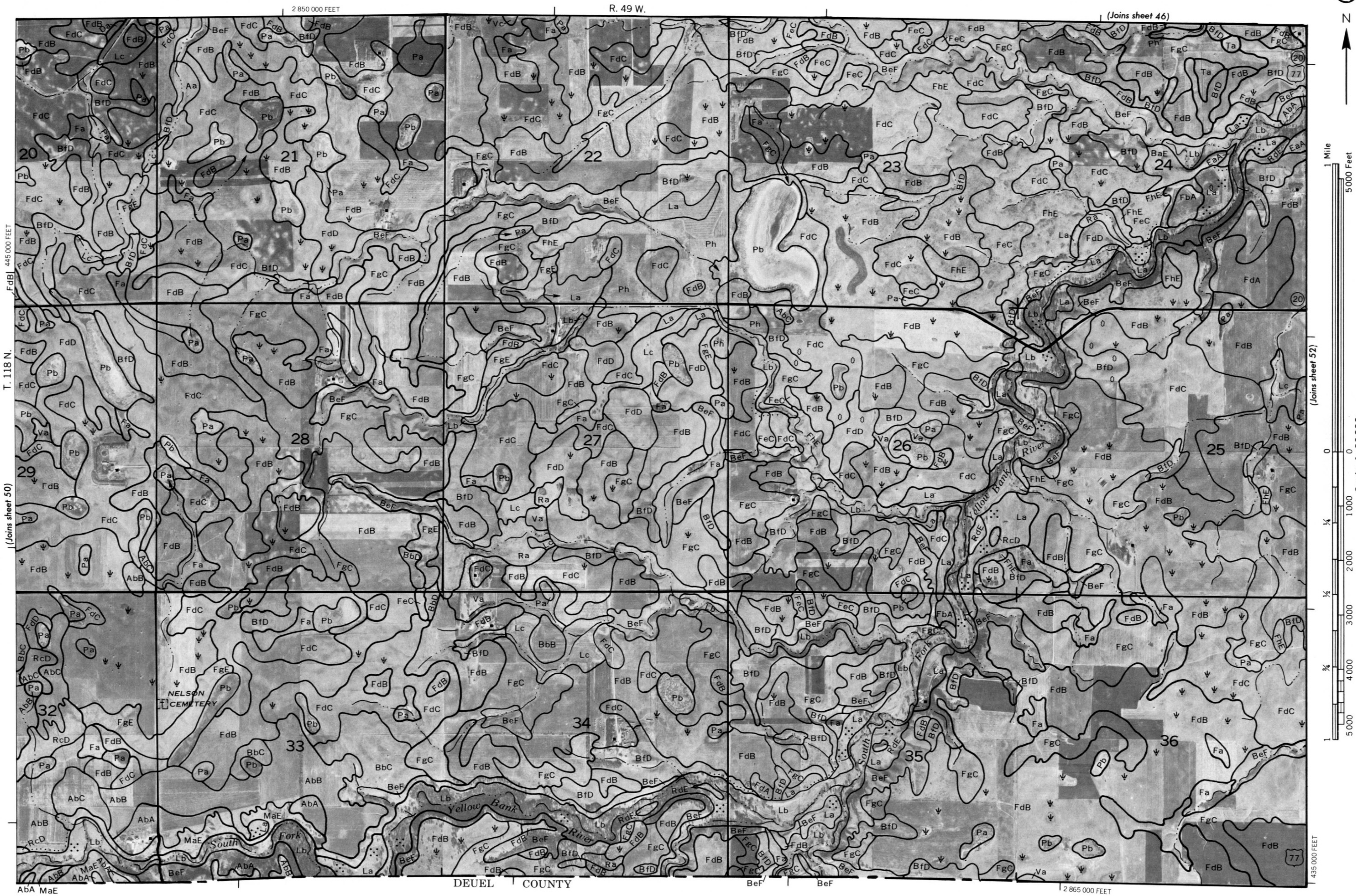


This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

GRANT COUNTY, SOUTH DAKOTA — SHEET NUMBER 50

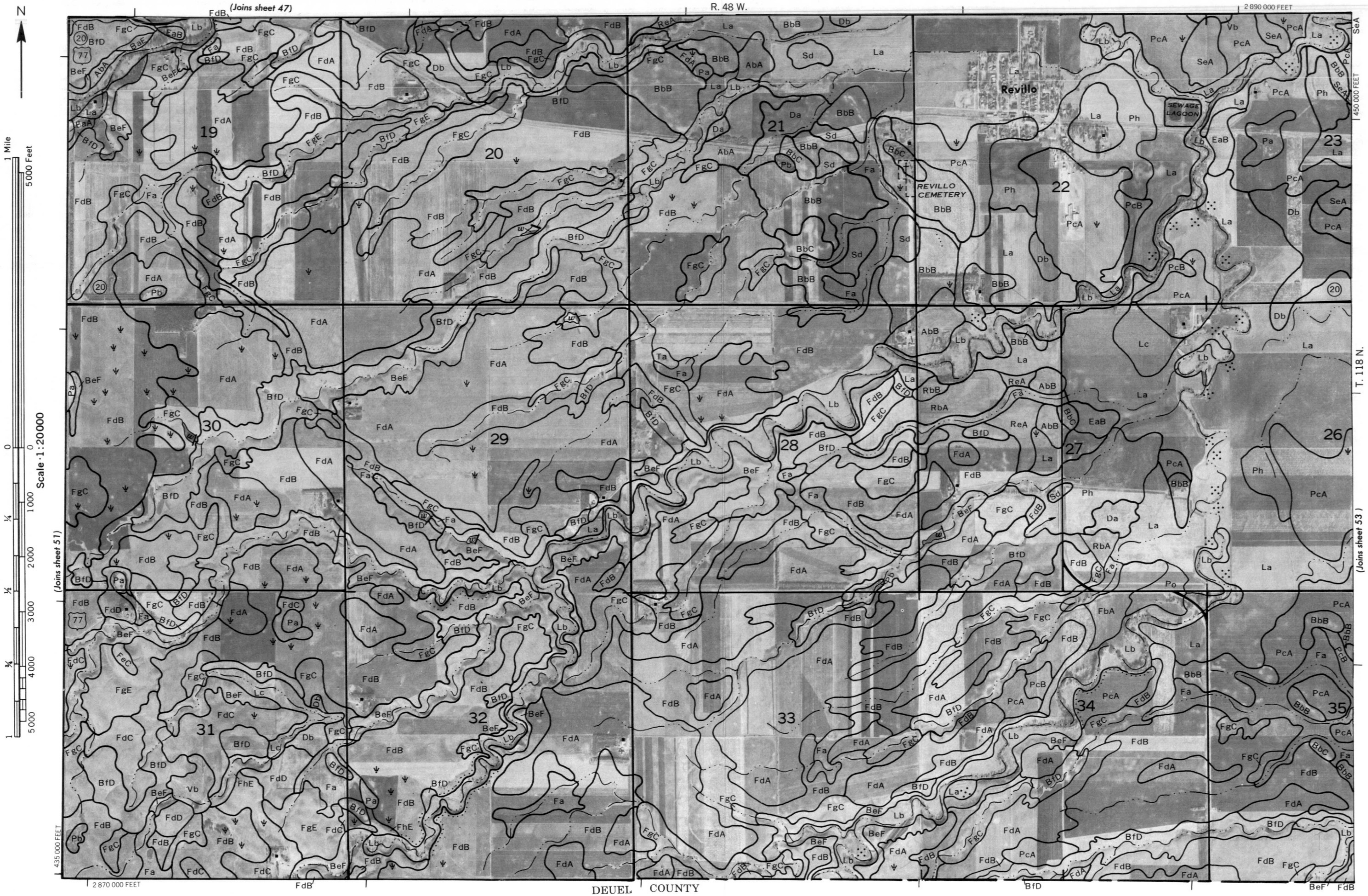


This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

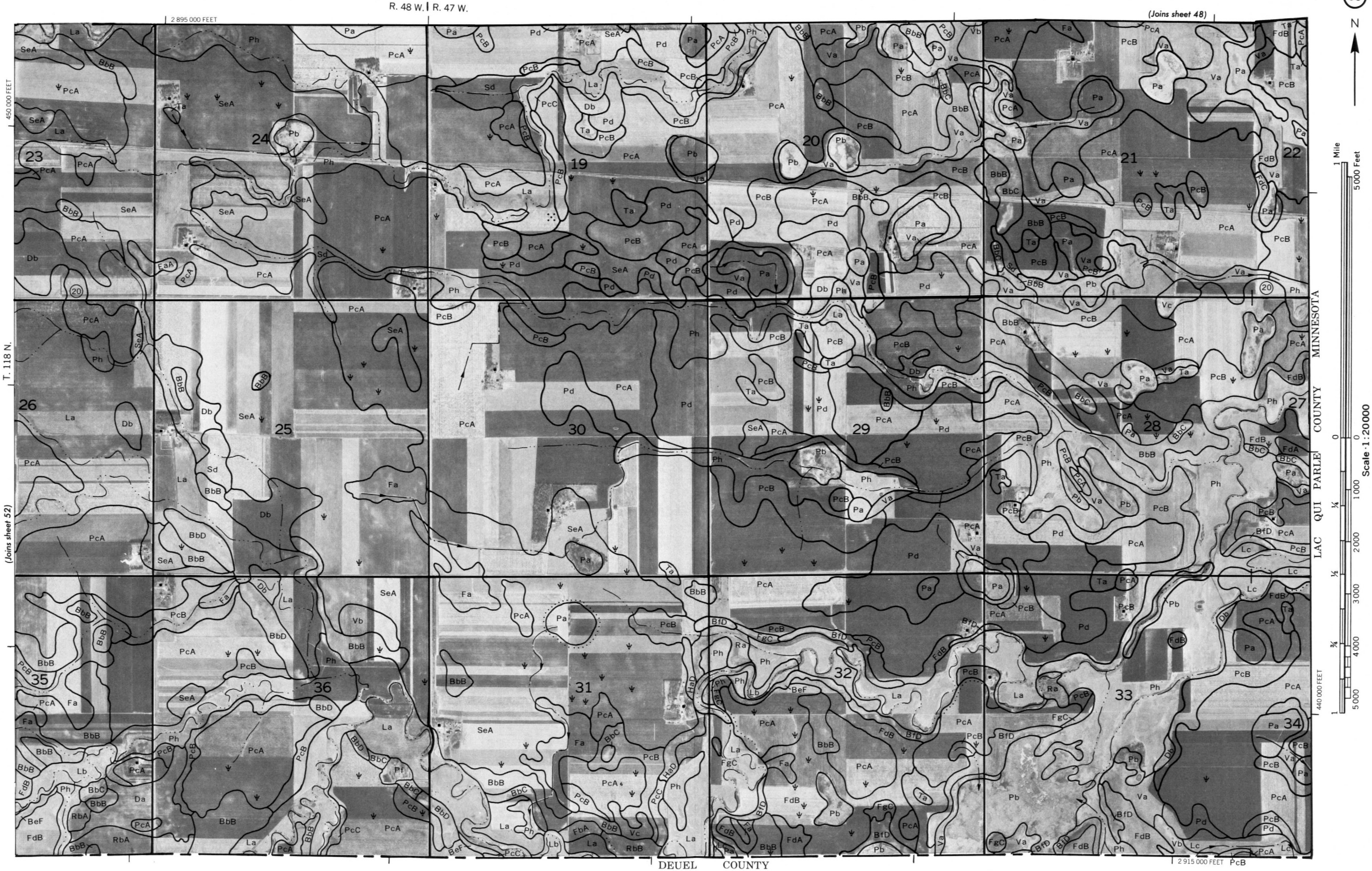
GRANT COUNTY, SOUTH DAKOTA — SHEET NUMBER 52



This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

GRANT COUNTY, SOUTH DAKOTA — SHEET NUMBER 53

53



This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.